I3S 2019

7th International Symposium on Sensor Science

09 – 11 May 2019, Napoli, Italy

Program and Abstract Book

7th International Symposium on Sensor Science

7th International Symposium on Sensor Science

MDPI • Basel • Beijing • Wuhan • Barcelona • Belgrade

Centro Congressi Federico II
Napoli, Italy
9–11 May 2019

Conference Chairs

Luigi Zeni Nunzio Cennamo Aldo Minardo

Session Chairs

Manel Del Valle, Spain
Letizia De Maria, Italy
Antonio Varriale, Italy
Bruno Andò, Italy
Leszek R. Jaroszewicz, Poland
Fabrizio Di Pasquale, Italy
Maria Pesavento, Italy
Pedro Jorge, Portugal
Alessandra Bossi, Italy
Lúcia Maria Botas Bilro, Portugal
Pietro Ferraro, Italy
Ramona Galatus, Romania

Scientific Committee

Stefano Mariani, Italy
Maria Pesavento, Italy
Pedro Jorge, Portugal
Alessandra Bossi, Italy
Kyriacos Kalli, Cyprus
Manuel Lopez-Amo Sainz, Spain
Genda Chen, USA
Larysa Baraban, Germany
Manel del Valle, Spain
Sabato D'Auria, Italy
Rogério Nogueira, Portugal
Francis Berghmans, Belgium
Waclaw Urbanczyk, Poland
Bruno Andò, Italy
Giovanni Cuniberti, Germany
Luís Carlos Coelho, Portugal

Organised by

Università degli Studi della Campania *Luigi Vanvitelli*

Conference Secretariat

Ester Catalano Agnese Coscetta
Suzie Li Lucia Russo

Contents

7th International Symposium on Sensor Science 9–11 May 2019, Napoli			
	Thursday 9 May 2019	**Friday 10 May 2019**	**Saturday 11 May 2019**
Morning	Check-in Opening Ceremony **Chairs: Luigi Zeni, Nunzio Cennamo & Aldo Minardo** *S1. Chemical Sensors*	*S3. Biosensors*	*S6. SPECIAL SESSION. Specialty Optical Fibers for Sensing* *S7. SPECIAL SESSION. Materials, Microfluidics, Configurations and Strategies for Sensing*
	Coffee Break	**Coffee Break**	**Coffee Break**
	S1. Chemical Sensors	*S3. Biosensors*	*S8. SPECIAL SESSION. Distributed Sensing in Optical Fibers*
	Lunch	**Lunch**	**Closing Remarks**
Afternoon	*S2. Sensor Applications*	*S4. Physical Sensors*	
	Coffee Break	**Coffee Break**	
	S2. Sensor Applications	*S5. Optical Sensors*	
	Poster Session 1	**Poster Session 2**	
		Social Events	

Thursday 9 May 2019: 08:00–13:00/14:15–19:45
Friday 10 May 2019: 09:00–12:45/14:15–19:00/**Conference Dinner: 20:00**
Saturday 11 May 2019: 09:00–14:30

Symposium Programme

Day 1: Thursday 9 May 2019

08:00–08:30	Check-in
08:30–09:00	Opening Ceremony

Session 1—Chemical Sensors (*Part 1*)
Chair: **Manel Del Valle**

09:00–09:30	**Sergey Piletsky—Invited Lecture** Novel Assay and Sensor Platforms Based on MIP Nanoparticles
09:30–09:45	**Hugues Brisset** Advanced Electrochemical Molecularly Imprinted Polymer as Sensor Interfaces
09:45–10:00	**Anja Drame** Nanostructured Molecularly Imprinted Polyaniline for Acrylamide Sensing
10:00–10:15	**Michael Tiemann** Highly Selective Sensing of H_2S Gas by a CuO/SiO_2 Nanocomposite
10:15–10:30	**Špela Trafela** Modified Nickel Nanowires for Electro-Catalytic Oxidation of Formaldehyde in Alkaline Solutions
10:30–10:45	**Sukon Phanichphant** WO_3 Loaded with Carbon-Based Materials as Nanocomposite NO_2 Gas Sensing
10:45–11:15	Coffee Break

Session 1—Chemical Sensors (*Part 2*)
Chair: **Maria Pesavento**

11:15–11:45	**Daniel Mandler—Invited Lecture** Nanoparticles Imprinted Matrices: A Method for Speciation of Nanoparticles
11:45–12:00	**Piotr Wiench** Electrochemical Performance of Dopamine Sensors Based on N-Doped Reduced Graphene Oxides with Different Type of Nitrogen Functional Groups as Electrode Materials
12:00–12:15	**Antonino Scandurra** Graphene Paper-Gold Nanostructured Electrodes Obtained by Laser Dewetting for High Sensitive Non-Enzymatic Glucose Sensing
12:15–12:30	**Manel del Valle** Comparison of Performance of Electronic Tongue Systems for Volatile Phenol Detection in Wine: Use of Modified Sensors, Molecularly-Imprinted Sensors and Enzyme-Based Biosensors
12:30–12:45	**Luis Coelho** Colorimetric Fiber Optic Based Probe for Real-Time Monitoring of Dissolved CO_2 in Aquaculture Systems
12:45–13:00	**Kristina Zagar Soderznik** $BaTiO_3$ Based Nanostructures for Humidity Sensing Applications
13:00–14:15	Lunch

Session 2—Sensor Applications (*Part 1*)
Chair: **Letizia De Maria**

14:15–14:45	**Corrado Di Natale—Invited Lecture** Combinatorial Selectivity of Porphyrins Based Gas Sensors
14:45–15:00	**Justyna Szerement**

	Seven-Rod Dielectric Sensor for Determination of Soil Moisture in Small Volumes
	David Valentin
15:00–15:15	Experimental-Numerical Design of a Bioreactor Prototype for Cell Vibration Experiments
15:15–15:30	**De Vito Saverio** Urban Participative Air Quality Sensor Network for Street Scale Assessments
	Cátia Magro
15:30–15:45	Triclosan Detection in Aqueous Environmental Matrices by Thin-Films Sensors: Impedantiometric Electronic Tongue
	Carosena Meola
15:45–16:00	The Contribution of Infrared Thermography in the Characterization of Glass/Epoxy Laminates Through Remote Sensing of Thermal-Stress Coupled Effects
16:00–16:30	Coffee Break

Session 2—Sensor Applications (*Part 2*)
Chair: **Pedro Jorge**

16:30–17:00	**Ellen Holthoff—Invited Lecture** Photonic Integrated Circuit Sensor for Human Performance Monitoring
	Paulo Zagalo
17:00–17:15	Detection of Triclosan in Tuned Solutions by pH and Ionic Strength Using PAH/PAZO Thin Films
	Josep Escrig
17:15–17:30	Predicting the Alcohol Content during Fermentation Using Sensor Measurements and Machine Learning
17:30–17:45	**Nicholas Watson** Monitoring the Different Stages of Industrial Cleaning Using Ultrasonic Sensors
	Francesco Fienga
17:45–18:00	Fiber Optic Monitoring System for Beam Induced Heating on High Energy Accelerator's Beam Pipes
	Priya Vizzini
18:00–18:15	Brettanomyces Bruxellensis Detection by Optical and Acoustic Biosensor in Comparison
18:15–18:30	**Alessandra Bonanni** Electroactive Nanocarbon as Novel Label for DNA Analysis
	Andrey Legin
18:30–18:45	Potentiometric Multisensor System for Plutonium Quantification in Spent Nuclear Fuel Reprocessing
18:45–19:45	**Poster Session 1**

Day 2: Friday 10 May 2019

Session 3—Biosensors (*Part 1*)
Chair: **Antonio Varriale**

	Simonetta Grilli—Invited Lecture
09:00–09:30	The Pyro-Electrohydrodynamic Jet Accumulation: A New Tool for High Sensitive Detection of Low Abundant Biomolecules
	Sara Tombelli
09:30–09:45	Intracellular Sensing by Molecular Beacons Coupled to Nanoparticles in Human Cancer Cells

	Gina Greco
09:45–10:00	Development and Characterization of an Ultra High Frequency (UHF) Love-Surface Acoustic Wave (L-SAW) Biosensor
	Riccarda Antiochia
10:00–10:15	Transdermal Microneedle Array-Based Biosensor for Real Time Simultaneous Lactate and Glucose Monitoring
10:15–10:30	**Ilaria Sorrentino** Bio-Functionalization of Graphene with a Laccase Hydrophobin Chimera
10:30–10:45	**Larysa Baraban** Smart Lab-on-a-Chip Nanosensor Platform for Cancer Diagnostics
10:45–11:15	Coffee Break

Session 3—Biosensors (*Part 2*)
Chair: **Alessandra Bossi**

	Monique Lacroix—Invited Lecture
11:15–11:45	Development of Rapid Immunodetection Tests of *Escherichia coli* O157: H7 and *Listeria monocytogenes* on Working Surfaces in Food Industries
11:45–12:00	**Elena Piletska** Identification Of Epitopes And Molecular Markers Using Molecular Imprinting
	Robert Crapnell
12:00–12:15	Smart Thermometers Functionalized with High Affinity Nanoparticles for the Thermal Detection of Cardiac Biomarkers
12:15–12:30	**Filippo Causa** Microgels for High Sensitive, Direct and Multiplexed miRNAs Optical Sensing
	Pallab Kumar Bairagi
12:30–12:45	Cobalt-Dispersed Reduced Graphene Oxide Nanocomposite for the Selective Electrochemical Detection of Methyl Nicotinate
12:45–14:15	Lunch

Session 4—Physical Sensors
Chair: **Bruno Andò**

14:15–14:45	**Massimo De Vittorio—Invited Lecture** Wearable Piezoelectric Sensor Technologies for Health Monitoring
	Arcady Zhukov
14:45–15:00	Novel Sensing Technique for Non-Destructive and Non-Contact Monitoring of the Composites
	Andrei Turutin
15:00–15:15	Pushing of Acoustic and Thermal Noises in Magnetoelectric Sensors Based on Bidomain Lithium Niobate
	Giuseppe Ruzza
15:15–15:30	Low-Cost MEMS Accelerometers for Tilt Measurement: Thermal Analysis, Compensation and Application
	Nicolas Glaser
15:30–15:45	Printed Pressure Sensor for Medical Devices: An Example for Tracheal Intubation Monitoring
15:45–16:15	Coffee Break

Session 5—Optical Sensors
Chair: **Lucia Bilro**

16:15–16:45	**José Luís Santos—Invited Lecture** Paths for Optical Sensing
16:45–17:00	**Marco Pisco** Opto-Mechanical Lab-On-Fiber Accelerometers
17:00–17:15	**Heeyoung Lee** Distributed Strain Measurement Using Power-Based Brillouin Sensor with Three Folded Dynamic Range
17:15–17:30	**Luca Palmieri** A Rugged Fiber Optic Pressure Sensor for Underground Water Level Monitoring
17:30–17:45	**Mikel Bravo Acha** Optical Fiber Sensors in Asphalt for Smart Cities Traffic Monitoring
17:45–18:00	**Dragan Indjin** Optical Feedback Interferometry with THz Quantum-Cascade Lasers: Progress in THz Sensing and Imaging
18:00–19:00	**Poster Session 2**
19:15–20:00	**Visiting 'Chiostro di Santa Chiara' and 'Presepe Napoletano di Santa Chiara'**
20:00	**Conference Dinner**

Day 3: Saturday 11 May 2019

Session 6—Specialty Optical Fibers for Sensing
Chair: **Leszek R. Jaroszewicz**

09:00–09:30	**Lucia Bilro—Invited Lecture** POF Sensors and Applications
09:30–09:45	**Demetrio Sartiano** Three Lobes Plastic Optical Fiber Bending and Rotation Sensor
09:45–10:00	**Leonardo Binetti** Measurement of Viscoelasticity of Sodium Alginate by Fibre Bragg Grating
10:00–10:15	**Evert Jonathan van den Ham** Enhanced IR-Based Optical Sensing of Phosphates in Aqueous Environment
10:15–10:30	**Alessandra Maria Bossi** Plasmonic Platform in Plastic Optical Fibers Combined with Molecularly Imprinted Nanogels to Sense Ultralow Protein Concentrations

Session 7—Materials, Microfluidics, Configurations and Strategies for Sensing
Chair: **Pietro Ferraro**

10:30–11:00	**Jaroszewicz R. Leszek—Invited Lecture** Innovative Fiber-Optic Rotational Seismograph
11:00–11:15	**Edmondo Battista** Peptide Assisted Imprinting for Turn-On Fluorescence Detection of Proteins
11:15–11:30	**Hannah Dies** Electrokinetic Assembly of Gold Nanoparticles into Sensitive and Functionalizable Surface-Enhanced Raman Scattering-Based Sensors
11:30–11:45	**Lisa Miccio** In-Flow Label-Free Imaging for Single Cell Analysis

	Matteo Parmeggiani
11:45–12:00	P3HT Processing Study for In-Liquid EGOFET Biosensors: Effects of the Solvent and the Surface
12:00–12:30	Coffee Break

Session 8—Distributed Sensing in Optical Fibers
Chair: **Fabrizio Di Pasquale**

	Yosuke Mizuno—Invited Lecture
12:30–13:00	Brillouin Optical Correlation-Domain Reflectometry: Current Status and Future Perspectives
	Sascha Liehr
13:00–13:15	Wavelength-Scanning Distributed Acoustic Sensing for Structural Monitoring and Seismic Applications
	Enis Cerri
13:15–13:30	High-Spatial Resolution Brillouin Sensing: Evaluation Tests for Temperature Monitoring in Aerospace Scenarios
	Ali Masoudi
13:30–13:45	60km Range Single-Ended Distributed Optical Fibre Vibration Sensor with In-Line Raman Amplification
	Yonas Muanenda
13:45–14:00	Dynamic Phase Retrieval in a High-SNR DAS Based on UWFBGs without Phase Unwrapping Using a Scalable Homodyne Demodulation and Direct Detection
14:00–14:30	**Closing Remarks & Awards Ceremony**

Poster Session 1 （Day 1: Thursday 9 May 2019）

65	Ki-Il Kim	Object Tracking Based on (m,k)-firm Model in Multimedia Wireless Sensor Networks
66	Arcady Zhukov	Magnetic Properties and Applications of Glass-Coated Ferromagnetic Microwires
67	Jaroszewicz R. Leszek	Optical System for Variable Depolarizer Characterization
68	Leonardo Pantoli	A remote WSN for rockfall monitoring in hostileenvironment
69	Vincenzo Romano Marrazzo	Analytical and Numerical Simulations of a Fast Wide-Range AWG-Based Interrogation Technique for FBG Sensor
70	Aristides Docoslis	Assembly of Nanostructures using an AC Electric Field for Detection and Identification of Analytes using Surface-Enhanced Raman Scattering (SERS)
71	Antoni Grau	Automatic generation of datasets for learning-based UAV pipe detection by computer vision
72	Rongshan Wei	Design of Double Three-Contact Vertical Hall Device Based on Conformal Mapping Technology
73	Ramona Galatus	Evanescent field monitoring for film thickness evaluation in metallic layer surface plasmon resonance biosensor setup
74	Vincenzo Romano Marrazzo	FBG-based monitoring system for smart tires application with wireless instrumentation under real-time rolling condition
75	Yuichiro Sakajiri	Feasibility Study on Fabric-Sheet Unified Sensing Electrode for Non-Contact In-Bed Measurements of ECG, Body Proximity and Respiratory Movement
76	Natiely Hernández Sebastián	Integrated bidirectional inductive-array design for power transfer in implantable BioMEMS
77	Wei Li Ang	Investigating changes to the biosensing mechanism by tuning the concentrations of Graphene Quantum Dots towards the optical detection of Ochratoxin A
78	Luis Coelho	Preliminary study for detection of hydrogen peroxide using a hydroxyethyl cellulose membrane
79	Basem Aljoumani	A comparison of classic and machine-learning approaches to determine soil salinity and soil water content using time domain reflectometry
80	Kiran Van der Laan	A Fluorescent Nanodiamond Biosensor: Towards Free Radical Sensing in Chronologically Ageing Yeast Cells
81	Abdul Ghaffar	A low Cost Wide Range Plane-in-out Displacement Measurement Sensor Based on Twisted Macro-Bend Coupling Method
82	Román Fernández	A PoCT microfluidic device based on monolithic HFF-QCM sensor array.
83	Luis Coelho	A Simple Spectral Interrogation System for Optical Fiber Sensors
84	Alhulw Alshammari	Adaptive and sensitive fibre-optic fluorimetric transducer for air- and water-borne analytes
85	Gina Greco	An ultra-high-frequency surface-acoustic-wave lab-on-chip for the detection of brain-pathology biomarkers
86	Juanjuan Li	Effects of Adhesive Parameters on Dispersion Characteristics of Ultrasonic Guided Waves in Composite Pipes

87	Agostino Iadicicco	Bi-dimensional deflection estimation by embedded fiber Bragg gratings sensors
88	Pablo Fanjul-Bolado	Chimera Protein based Disposable Biosensor for the Electrochemical Monitoring of Polyphenolic Compounds
89	Kun Li	Chinese Traditional Musical Instrument Evaluation Based on a Smart Microphone Array Sensor
90	Elliot Woolley	Cleaning Assurance for Reusable Plastic Packaging using Ultraviolet Induced Fluorescence
91	Akinori Ueno	Comparison of Underwater ECG Measurement between Voltage-Based and Current-Based Methods Using Hydrophobic Silicone Electrode
92	Huichao Yan	Denoising of MEMS Vector Hydrophone Signal Based on Empirical Model Wavelet Method
93	Vincenzo Marletta	Design and characterization of a pressure sensor based on FBG on steel substrate
94	Salvatore Pirozzi	Design of a Force/Tactile Sensor for Robotic Grippers
95	Laura Fernández Llano	Development of a rapid and simple sensor for determination of catalase activity in real samples
96	Ramona Galatus	Identification of dynamic models for temperature sensors in hyperthermic chemotherapy
97	Yossi Rosenwaks	Sensitive and Selective NH3 Detection under High Humidity using Electrostatically Formed Nanowire (EFN) Transistor
98	Pierre Mullot	ECOCAPTURE: Eye tracking access to apathy in real-space ecological environment. Gaze behavior in frontotemporal dementia
99	Aymen Mousli	ECOCAPTURE: Quantifying apathy in frontotemporal dementia with eye tracking measures performed in real-space ecological environment
100	Eliska Sedlackova	Effect of graphene oxide modification on a DNA biosensor developed for the detection of methylated DNA associated with cancer
101	Benoit Piro	Electrolyte Gated Organic Field Effect Transistors for Chemical Monitoring of Living Cells
102	Giuseppe Quero	Engineered Lab-On-Fiber SERS Optrodes based on Nanosphere Lithography
103	Grażyna Gryglewicz	Enhanced performance of GCE/N-reduced graphene oxide-Au nanocomposite in dopamine sensing
104	Paola Zuppella	Exploiting several buffer layers in SPR D-shaped POF sensors based on gold film for different applications.
105	Marco Consales	Fiber optic sensors integrated in aircraft landing gears for load monitoring

Poster Session 2 （Day 2: Friday 10 May 2019）

106	Rubin Gulaboski	Getting Insight into Enzymes Kinetics and Thermodynamics via Theoretical Models in Protein-film Square-wave Voltammetry
107	Moonsuk Yi	Improved Sensitivity of Urchin-like ZnO Nanostructures with Added Two-Dimensional Electron Gas in MgZnO/ZnO Interfaces.
108	Emilia Damiano	Investigating the progressive failure of unsaturated granular soil through a small-scale physical slope model and a high spatial resolution distributed strain sensor
109	Filipa Sequeira	Low-cost sensing with plastic optical fibers - from turbidity and refractive index to chemical sensing
110	Ilya Kubasov	Low-frequency vibration sensor with a sub-nm sensitivity using a bidomain lithium niobate crystal
111	Riccardo Funari	Monitoring Bacterial Biofilm Formation Using LSPR Sensors for Biofilm Specific Drug Screening
112	Henri Nouws	Nano- and micro material-based electrochemical bioassays for the non-invasive electrochemical detection of HER2-ECD, a breast cancer biomarker
113	Cosimo Trono	Novel fabrication technique of superimposed LPG with different grating pitches for the simultaneous detection of refractive index and temperature
114	Reem Sweid	Modeling Tools for the Optimization of Optical Fiber Tweezers
115	Rodrigo Munguía	Observability Analysis for Parameter Identification of a Quadrotor
116	Nerea De Acha	Optical fiber luminescent aptasensor for the detection of Hg2+ ions in aqueous media
117	Kyoung Won Jang	Optical Filters Embedded Fiber-optic Radiation Sensors for Radiotherapy Dosimetry
118	Letizia De maria	Optical voltage transducer for embedded medium voltage equipment: design and parameters optimization
119	Marcus Wolff	Photoacoustic detection of short-chained hydrocarbon isotopologues
120	Juhani Virtanen	Piezoelectric dual axis cantilever sensor for dynamic low force measurements on an open source based platform
121	Alessandro Chiado'	Plasmonic nanostructures integrated in microfluidic chips for the sensitive SERS detection of miRNAs
122	Maria Pesavento	Plasmonic optical fiber sensors and molecularly imprinted polymers for food safety applications
123	Anna Rita Bizzarri	Portable Immunosensor Based on Extended Gate – Field Effect Transistor for Rapid, Sensitive Detection of Cancer Markers
124	Xianjing Li	Position measurement based on fisheye imaging
125	Zeljka Cvejic	Potential of sumanene modified with boron and nitrogen atoms for adsorption of carbon dioxide: DFT and SAPT study
126	Dermot Diamond	Real-time analysis of electrolytes in sweat through a wearable sensing platform
127	Jun-Xiang Zhang	Robot-Assisted Acupuncture

128	Elena Korotkova	Selection of optimal stabilizers for silver nanoparticles as labels for electrochemical sensors
129	Agostino Iadicicco	Sensing Features of Arc-induced Long Period Gratings
130	Maria Pesavento	Sensing of copper(II) by immobilized ligands: comparison of electrochemical and surface plasmon resonance transduction.
131	Maria Pesavento	Sensing of furfural by molecularly imprinted polymers on Plasmonic and Electrochemical platforms
132	Jaroslava Bezděková	Sensing of nucleic bases based on molecularly imprinted polymers
133	David Valiente	Dynamic catadioptric sensory data fusion for visual localization inmobile robotics
134	Niccolò Paccotti	SERS analysis of bacterial strains: Escherichia coli and Staphylococcus epidermidis
135	Duarte Viveiros	Spectral tuning of Long Period Fiber Gratings fabricated by Femtosecond laser micromachining through thermal annealing
136	Raquel Cervigon Abad	Suitability of general purpose PPG-based wearable devices for HRV analysis
137	Giuseppe Quero	Ultra-high Dose Monitoring with Innovative Lab-on-Fiber Radiation Dosimeter
138	Christophe Delebarre	Wireless air quality sensor systems for pollution mapping.
139	Michele Riccio	Wireless electronic sensing system for real-time monitoring of pneumatic tires
140	Stefano Boscarino	ZnO-MWCNTs hybrid layer for UV light detection
141	Carlo Trigona	A Green slab waveguide for plasmonic sensors based on Bacterial Cellulose
142	Yijie Sun	OFDR Sensing Technology based Distributed Monitoring and Stability Analysis of Geogrid-Reinforced-Slope
143	Vinicius Kartnaller	Development of a Real Time Image Analysis Sensing Methodology for pH Measurement in Pressurized Systems and Application for CO2-H2O Systems

Welcome from the Chairs

Dear Colleagues,

Sensor's technology has shown to be suitable for applications in many important fields, including pharmaceutical researches, medical diagnostics, environmental monitoring, industrial applications, food safety and security. Sensor's technology represents the ideal turf to foster the development of innovative applications, measurement schemes and strategies, comprising the exploitation of transducers, smart materials, receptors, nanostructures and so on. This international conference, supported by the journal *Sensors*, brings together scientists from different areas to discuss important recent developments in sensor's technology. It represents an opportunity to meet an interdisciplinary community willing to discuss on important breakthroughs in sensor's technology and related fields.

It is a great pleasure to welcome you in Napoli for this sensors congress!

Luigi Zeni
Nunzio Cennamo
Aldo Minardo

Invited Speakers

Monique Lacroix

INRS-Institut Armand Frappier, Canada

Yosuke Mizuno

Tokyo Institute of Technology, Japan

Sergey A. Piletsky

University of Leicester, UK

José Luís Santos

University of Porto, Portugal

Corrado Di Natale

Università di Roma Tor Vergata, Italy

Simonetta Grilli

CNR-ISASI, Pozzuoli, Italy

Ellen L. Holthoff

U.S. Army Research Laboratory Adelphi, MD, USA

Daniel Mandler

Institute of Chemistry, The Hebrew University of Jerusalem, Israel

Massimo De Vittorio

Istituto Italiano di Tecnologia & Università del Salento, Italy

Leszek R. Jaroszewicz

Military University of Technology, Poland

Lúcia Maria Botas Bilro

Institute of Telecommunications, Department of Optical Communications, Lisbon, Portugal

Conference Venue

The conference will be held at the **Centro Congressi Federico II, Via Partenope, 36—Napoli, Italy**.

In **Naples**, you can revisit the history and development of the city by means of itineraries from the very first settlements, passing through places with testify to the past, but which only occasionally show clear signs of events while more often tending to stimulate the imagination.

The starting-point is Partenope, which was founded about 3000 years ago, and the point of arrival the new city, Neapolis, the real historical centre and heart of the modern metropolis. As we go along the roads that have become part of Partenopean history and culture, we discover archeological and sites and examples of art which are unique. The cult of the dead, which so much typifies the culture of the Neapolitans, comes alive in the mysterious scenario of the Necropolis of the Sanità. Approaching the hill of Posillipo, our journey ends with an itinerary which leaves us enchanted by the extraordinary beauty of the natural scenery which the ancient Romans learned to love.

Naples has a very important cultural and historical heritage, a fantastic cooking, an international airport in the city center and, in the near surroundings, you can find several important sites, such as **Pompei and Vesuvius, Ercolano, Capri, Ischia, Procida, Sorrento, Positano, Amalfi, Pozzuoli and Phlegrean Fields with the Solfatara crater etc.**

Social Events

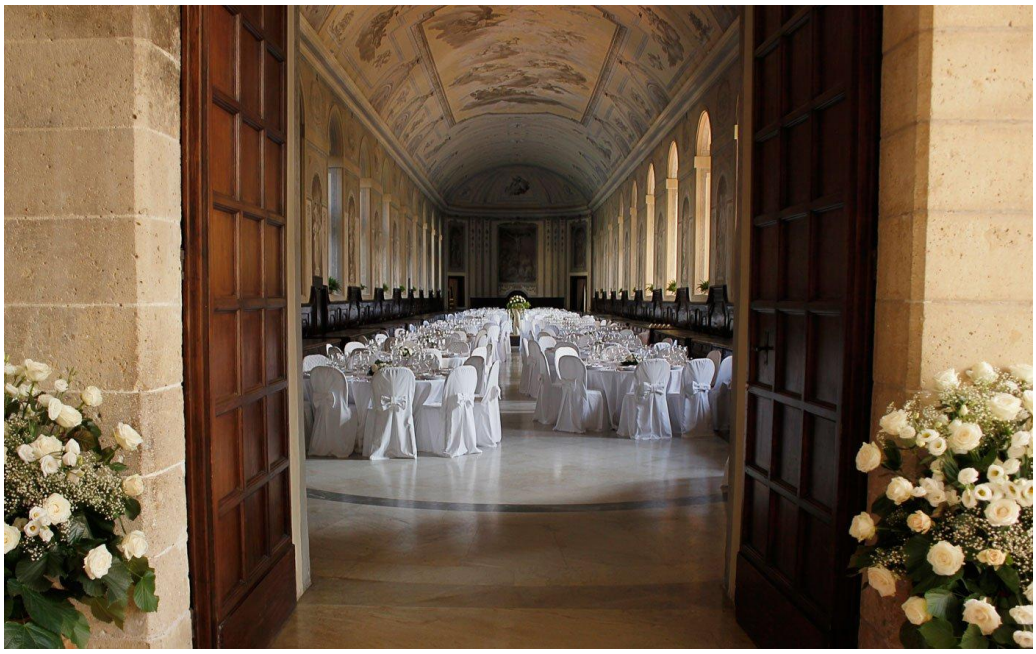
Visiting 'Chiostro di Santa Chiara' and 'Presepe Napoletano di Santa Chiara'

We are glad to announce that in the evening of **Friday 10 May at 19:00 h** we will be visiting the 'Chiostro di Santa Chiara' and 'Presepe Napoletano di Santa Chiara', two must-see of the 'Complesso Monumentale di Santa Chiara' in Naples.

Time: **Friday 10 May at 19:00 h**
Location: **'Complesso Monumentale di Santa Chiara'**
Address: **49/c, Via Santa Chiara, Naples**

Conference Gala Dinner

On that same day at **20:00 h**, after our visit to the 'Complesso Monumentale di Santa Chiara', we invite you to remain at 'Antico Refettorio di Santa Chiara' for the Conference Gala Dinner.



Time: **Friday 10 May at 20:00 h**
Location: **'Antico Refettorio di Santa Chiara'**
Address: **49/c, Via Santa Chiara, Naples**

What is Sciforum?

Sciforum is an event planning platform that supports open science by offering the opportunity to host and participate in academic conferences. It provides an environment for scholarly exchange, discussion of topics of current interest, building of networks and establishing collaborations.

The Benefits of Sciforum

Sciforum helps conference organizers to run online and physical conferences efficiently. The organizers reduce their administrative efforts thanks to an online tool that supports all aspects of conference organization, including setting up and maintaining the conference website, managing the peer-review process, publishing the conference proceedings, handling and coordinating the conference schedule, registration, billing, sponsors, etc.

We are here to help you to

- Set up your conference website
- Handle abstract & full paper submission and peer review
- Handle online registrations and billing
- Build your conference program & schedule, record the conference income & expenses
- Build customized mailing lists
- Have access to useful data from your conference (participants list, registration details, book of abstracts, etc.)
- Copy-edit, manage & publish your conference proceedings
- Manage Awards & post event surveys

For more information, please visit: **www.sciforum.net**

For any queries, please contact: **info@sciforum.net**

Abstract

1. Advanced Electrochemical Molecularly Imprinted Polymer as Sensor Interfaces

Catherine Branger and Hugues Brisset *

MAPIEM Laboratory, University of Toulon

* Correspondence: brisset@univ-tln.fr

Molecularly Imprinted Polymers are three-tridimensional polymers network prepared around a molecular template. After template releasing MIPs have binding cavities which retain shape, size and orientation of the target molecule [1].

We developed since a few years electrochemical molecularly imprinted polymers (e-MIP) by integration of a redox probe inside the binding cavities of cross-linked MIPs during their synthesis. The detection of target molecule is based on the electrochemical answer of the redox probe [2]. This new concept was first established for the detection of benzo[a]pyrene with vinyl-ferrocene used as redox probe and as functional monomer [3,4]. Recently, we have extended this strategy to the detection of Bisphenol A using ferrocenyl methyl methacrylate as functional redox tracer. In all cases, the detection is based on the pi-pi interactions between the aromatic rings of the target molecules and the aromatic cyclopentadienyl rings of ferrocene, thus leading to the modulation of ferrocene redox properties. These new e-MIP microbeads particles were incorporated in a graphite paste to prepare screen-printed carbon electrodes. A highly sensitivity for BPA in aqueous medium was obtained with a limit of detection of 0.06 nM [5].

References

1. Haupt, K.; Mosbach, K. *Chem. Rev.* **2000**, *100*, 2495.
2. Branger, C.; Brisset, H.; Udomsap, D. French Patent FR 1262617, PCT/IB2013/061196.
3. Udomsap, D.; Branger, C.; Culioli, G.; Dollet, P.; Brisset, H. *Chem. Comm.* **2014**, *50*, 7488.
4. Udomsap, D.; Brisset, H.; Culioli, G.; Dollet, P.; Laatikainen, K.; Siren, H.; Branger, C. *Mater. Today Commun.* **2018**, *17*, 458.
5. Mba Ekomo, V.; Branger, C.; Bikanga, R.; Florea, A.-M.; Istamboulie, G.; Calas-Blanchard, C.; Noguer, T.; Sarbu, A.; Brisset, H. *Biosens. Bioelectron.* **2018**, *112*, 158.

Abstract

2. Graphene Paper-Gold Nanostructured Electrodes Obtained by Laser Dewetting for High Sensitive Non-Enzymatic Glucose Sensing

Antonino Scandurra [1,*], Francesco Ruffino [1,2] and Maria Grazia Grimaldi [1,2]

[1] Department of Physics and Astronomy "Ettore Majorana", University of Catania, via S. Sofia 64, 95123 Catania, Italy
[2] CNR-IMM via S. Sofia 64, 95123 Catania, Italy
* Correspondence: ascandurra63@gmail.com

Electrodes for non-enzymatic glucose sensing based on gold nanostructures onto graphene paper (GP-AuNPs) have been obtained inducing dewetting, by laser annealing, of a 8 nm-thick Au layer deposited by sputtering. Molten-phase dewetting of gold layer, which produces the formation of spherical nanoparticles (AuNPs), was achieved by nanosecond laser annealing using a pulsed (12 ns) Nd: yttrium aluminum garnet YAG laser operating at 532 nm. The Surface of the electrode presents gold rich regions consisting of graphene nanoplatelets covered by spherical AuNPs. The sizes of AuNPs are in the ranges 10–20 nm and 100–150 nm. Glucose was detected at a potential of 0.17 V vs. SCE, which corresponds to the intense peak of two electrons oxidation. Highest sensitivity of 600 μA mM^{-1} cm^{-2} of glucose detection was obtained. The resulting sensitivity, detection limit and linear range for the glucose detection are very promising since comparable to the actual state of art results for nanostructured gold electrodes which are, however, produced by complex multi-steps processes.

Abstract

3. $BaTiO_3$ Based Nanostructures for Humidity Sensing Applications

Kristina Zagar Soderznik [1,*], Cristian Fabrega [2], Francisco Hernandez-Ramirez [2], Joan Daniel Prades [2] and Miran Ceh [1]

[1] Department for Nanostructured Materials, Jožef Stefan Institute, Jamova cesta 39, 1000 Ljubljana, Slovenia
[2] Department of Electronics and Biomedical Engineering, University of Barcelona, Marti i Franquès 1, 08028 Barcelona, Spain
* Correspondence: kristina.zagar@ijs.si

Our contribution focuses on humidity gas-sensing device formation of one dimensional metal oxide materials such as $BaTiO_3$ nanorods and on TiO_2-$BaTiO_3$ nanotubes. Processing of humidity sensors based on $BaTiO_3$ nanostructured material, that can operate under severe environmental conditions is of great relevance due to their small size and small weight. As a result, these sensors possess high stability, fast response times and reproducibility. Furthermore, gas sensor properties are not only interesting in terms of device applications, but also pave the way to study in deep ionic and electronic conduction mechanisms in individual nano-based devices.Two electrochemical processing principles were used for the formation of $BaTiO_3$ nanorods and TiO_2-$BaTiO_3$ nanotubes. Namely, sol-gel electrophoretic deposition technique and electrochemical anodization technique followed by hydrothermal treatment. To study electrical properties, devices were fabricated by focused ion beam nanolithography techniques or by sputtering.Obtained nanostructures with lengths between 5 and 30 μm and diameters of approximately 100–200 nm were polycrystalline, with grains ranging between 10–20 nm in size. We investigated the humidity sensing properties, such its sensitivity, linearity, reproducibility and stability. The measurements of electrical resistivity of $BaTiO_3$ nanostructures in varying humidity environment showed reproducible response, thus demonstrating that they can be integrated in architectures with functional capacities of a humidity nano-sensor.

Abstract

4. Colorimetric Fiber Optic Based Probe for Real-Time Monitoring of Dissolved CO_2 in Aquaculture Systems

João Mendes [1,2,*], Luis Coelho [1], André Rocha [3], Carlos Pereira [2], Barna Kovacs [4], Pedro Jorge [1,5] and Teresa Borges [3,6]

[1] INESCTEC—Institute for Systems and Computer Engineering, Technology and Science and Faculty of Sciences, University of Porto, Rua do Campo Alegre, 4169-007 Porto, Portugal
[2] CIQUP, Chemical and Biochemical Department, Faculty of Sciences, Porto University, Portugal
[3] CIIMAR—Interdisciplinary Centre of Marine and Environmental Research, Porto University, Portugal
[4] Department of General and Physical Chemistry, Pécs University, Pécs, Hungary
[5] Department of Physics and Astronomy of Faculty of Sciences, University of Porto, 4169-007 Porto, Portugal
[6] Department of Biology, Faculty of Sciences, Porto University, Portugal
* Correspondence: joaomendes.quimica@gmail.com

Dissolved carbon dioxide (dCO_2) evaluation is very important in many different fields as ocean, river and lake monitoring, food industry control (e.g., aquaculture) and clinical analysis. So far, there are some different methods for CO_2 measurements, including gas chromatography, colorimetry, amperometry, potentiometry, UV/Vis spectrophotometry and IR spectrometry. These methods are time-consuming, expensive and usually not suitable for real-time monitoring of dCO_2. In the last years, several authors developed optical fiber-based technology for real time detection and quantification of dCO_2. In this work, it was developed a new, integrated, colorimetric-optical fiber-based system for dCO_2 monitoring in aquaculture industry. The sensing chemistry is based on colorimetric changes of the used indicator—*p*-nitrophenol (pNPh)—in contact with CO_2. To increase the sensitivity of the sensing membrane, the indicator was polymerized, and its derivatives used to make the sensing cocktail. The resulting sensing layer was attached to an optical fiber probe in transmission mode illuminated with integrated dual wavelength LED. In the presence of carbon dioxide, the sensing layer changes its optical properties (absorption and refractive index), which changes the posterior optical response. This response is analyzed by a computer software specially developed for this purpose. Preliminary tests were done in a laboratory environment (calibration) and in a laboratory Recirculating Aquaculture simulating System (RAS) with a controlled CO_2 injection. The results showed the suitability of the new sensor for assessing dCO_2 dynamics and its fast detection of low concentrations of dCO_2 in an appropriate operation range.

Abstract

5. Comparison of Performance of Electronic Tongue Systems for Volatile Phenol Detection in Wine: Use of Modified Sensors, Molecularly-Imprinted Sensors and Enzyme-Based Biosensors

Manel del Valle *, Andreu Gonzàlez-Calabuig, Anna Herrera-Chacon and Marta Bonet-San-Emeterio

Universitat Autonoma de Barcelona
* Correspondence: manel.delvalle@uab.es

This work presents a comparison study in the analysis of volatile 4-ethyl phenolic compounds as wine defect through the use of novel materials in voltammetric sensors plus the application of electronic tongue principles, that is the use of an array of sensors having cross sensitivity features and advanced chemometric tools for data processing. Three electronic tongue analysis systems were put into work and contrasted, first using voltammetric sensors, second using tailor-made molecularly imprinted polymers (MIPs) and third using laccase and tyrosinase enzyme biosensors. High dimensionality generated data were processed in two stages, previously data was *compressed* using discrete Wavelet transform, next transformed coefficients were fed into an artificial neural network numerical model for estimating concentration. Compounds determined were the three volatile phenols characteristic of the Brett defect in wine, namely 4-ethylphenol, 4-ethylcatechol and 4-ethylguayacol; these undesired compounds, manifest in low concentrations, may spoil wine production batches associated to proliferation of Brettanomyces yeast, an event needed to be detected if happening.

Abstract

6. Electrochemical Performance of Dopamine Sensors Based on N-Doped Reduced Graphene Oxides with Different Type of Nitrogen Functional Groups as Electrode Materials

Piotr Wiench [1,*], Zoraida González [2], Rosa Menéndez [2] and Grażyna Gryglewicz [1]

[1] Faculty of Chemistry, Wrocław University of Science and Technology, Poland
[2] Instituto Nacional del Carbón (INCAR-CSIC), Oviedo, Spain
* Correspondence: piotr.wiench@pwr.edu.pl

Dopamine (DA) sensing parameters were evaluated using three different nitrogen-doped reduced graphene oxides (N-rGOs) as active materials. The N-rGOs were obtained by hydrothermal treatment of graphene oxide (GO) in the presence of various N-dopants, such as amitrole, urea and julolidine, resulting in graphene materials showing a different nitrogen groups distribution. The N-rGOs were subsequently used to modify a glassy carbon electrode (GCE) and tested as electrode materials of DA electrochemical detection. After optimization of the working pH and sensor calibration, it was revealed that the GCE/pyrrolic-N-rGO exhibited the best DA sensing parameters among the tested materials, presenting a low limit of detection (LOD) of 335 nM, a linear range of 0.5–85 μM, simultaneously maintaining high sensitivity (3.51 μA/μM). For the pyrrolic-N-rGO, the influence of typical interferents, such as ascorbic (AA) and uric (UA) acids, on the DA oxidation signal was the smallest one among all synthesized graphene materials. Therefore, the pyrrolic-N-rGO is recommended as the modifier of the GCE electrode in order to obtain DA electrochemical sensors withthe best sensing parameters.

Abstract

7. Highly Selective Sensing of H_2S Gas by a CuO/SiO_2 Nanocomposite

Andrej Paul, Christian Weinberger, Michael Tiemann * and Thorsten Wagner

Paderborn University

* Correspondence: michael.tiemann@upb.de

We present a composite material of copper oxide (CuO) nanoparticles inside the pores of nanoporous KIT-6 silica (SiO_2). The material is used for the dosimetric detection of hydrogen sulphide gas (H_2S) in low ppm concentrations. The system is based on the chemical conversion of CuO to copper sulfide (CuS) at low temperature (160 °C): $CuO + H_2S \rightarrow CuS + H_2O$. Since CuS is highly conductive ('metallic' CuS), the reaction results in a strong increase of electronic conductivity (measureable). The sensor is, therefore, highly selective to H_2S. The reaction is reversible; CuO is regenerated by heating to 350 °C in air (with or without H_2S). Long-time stability of our system allows for repeated cycles of measurement and regeneration. This is possible due to the fact that the CuO/CuS nanoparticles are embedded in the nanoporous matrix. Even though severe volume expansion and shrinkage of the particles take place during each cycle, no overall morphological changes in the sensing material occur, which ensures a stable long-term sensing performance. The sensor response is marked by a percolation-type mechanism. Upon exposure to H_2S the conductance remains low for a certain induction time during which CuS is gradually formed. Once the percolation threshold is reached, a continuous conduction path forms and the conductance shows a steep increase. The length of the induction period depends on the H_2S concentration; hence, measuring this time period allows for assessment of the H_2S concentration (after calibration).

Abstract

8. Modified Nickel Nanowires for Electro-Catalytic Oxidation of Formaldehyde in Alkaline Solutions

Špela Trafela [1,2]

[1] Department for Nanostructured Materials, Jožef Stefan Institute, Jamova 39, Si-1000 Ljubljana, Slovenia; spela.trafela@ijs.si

[2] Jožef Stefan International Postgraduate School, Jamova 39, Si-1000 Ljubljana, Slovenia

Modified Ni nanowires were investigated for the electro-oxidation of formaldehyde (HCHO), which are promising to be used as effective electrochemical receptor element. A Ni nanowire arrays (200 nm diameter, retaining the size 2.3 μm) for HCHO detection were generated by electrodeposition of Ni into AAO template. Ni nanowires based electrode was further treated with KOH to prepare Ni-NiO(OH)/$Ni(OH)_2$ electrode using cyclic voltammetry. Such electrode was further used as electro-catalytic material for detection of HCHO. The investigation of the electrochemical behaviour of HCHO electro-oxidation in 0.1 mol L^{-1} NaOH solution at the surface of Ni-NiO(OH)/$Ni(OH)_2$) nanowires were carried out by cyclic voltammetry and chronoamperometry. Obtained results from cyclic voltammograms showed that HCHO oxidation peak current density increases drastically with increasing formaldehyde concentrations, but the onset potential shifted to more positive as a result of IR drop. Amperometric measurements confirmed that modified Ni NWs based receptor elements are sensitive to HCHO exhibit a fast response time (3 s) and a very good sensitivity (0.34 mA L cm^{-2} $mmol^{-1}$ and 0.04 mA L cm^{-2} $mmol^{-1}$) and a very low detection limit of 0.8 μmol L^{-1} (80 ppb). Measured LOD in the ppb region is comparable to noble-metal based HCHO receptor elements and surpass those achieved for nanostructured noble metals and other reported Ni—based electrodes.

Abstract

9. Nanoparticles Imprinted Matrices: A Method for Speciation of Nanoparticles

Daniel Mandler *, Netta Bruchiel-Spanier, L. Dery and Maria Hitrik

Institute of Chemistry, The Hebrew University of Jerusalem

* Correspondence: daniel.mandler@mail.huji.ac.il

This contribution deals with a new area that aims to detect selectively nanoparticles (NPs). With the benefits that NPs bring due to their unique properties that are a result of their size, they also pose a threat. Indeed, nanotoxicology is a new discipline, which deals with the adverse effects of NPs. Evidently, the detection of NPs requires the development of appropriate tools. These interactions are affected by the core, size, shape, and stabilizing shell of the NPs. Hence, **speciation of NPs**, is becoming of utmost importance.

We have developed a new concept for the selective recognition and detection of NPs termed **NPs imprinted matrices (NAIM)**. It is analogous to the well-known concept of molecularly imprinted polymers (MIP) in which the molecular analyte is imprinted in a polymer by polymerization of proper monomers with which it chemically associates. The removal of the template forms complementary cavities capable of selective recognition of the analyte. Instead of molecular species, we imprint NPs in various matrices. The NPs are then removed to form nanometric voids that can selectively recognize the originally imprinted NPs.

We will present a few new systems by which we show how NPs can be imprinted inside a matrix. What are the conditions for their removal and reuptake and what makes the matrix selective and sensitive towards the originally imprinted NPs.

Abstract

10. Nanostructured Molecularly Imprinted Polyaniline for Acrylamide Sensing

Anja Drame [1,2]

[1] Department for Nanostructured Materials, Jožef Stefan Institute, Jamova 39, Si-1000 Ljubljana, Slovenia; anja.drame@ijs.si

[2] Jožef Stefan International Postgraduate School, Jamova 39, Si-1000 Ljubljana, Slovenia

---

Polyaniline (PANI) nanofibers prepared by electropolymerization in acidic solution were studied as a potential basic material for molecularly imprinted polymer (MIP) system for acrylamide (AA) detection. Polymerization was performed by electrochemical techniques in HCl on screen-printed electrode (SPE)—systems with a gold working electrode, platinum counter electrode and a silver reference electrode. Using different electrochemical techniques (cyclic voltammetry, chronopotentiometry, chronoamperometry), caused formation of PANI in the form of nanofibers or nanoparticles according to the FEG-SEM analysis. An elemardine salt, which is the most conductive form of polyaniline, was confirmed by its characteristic peaks obtained by FTIR and by observed characteristic green colour of polymerized working electrode. Polymerization stages of PANI formation was observed by stopping its polymerization at certain achieved currents in cyclic voltammetry. By analysing one of the most characteristic anodic current peak for PANI formation (transition between leucoemelardine to emelardine phase), the deposited mass and the film thickness was calculated by using Faraday's law. Imprinted PANI was prepared by adding template molecule—propinoamide (PAM—structural analogue to acrylamide) into starting polymerization suspension. FTIR results showed two new peaks in the range of 2849 and 2924 cm^{-1}, characteristic for alkanes, which confirms successful imprinting of propanamide. Direct detection of acrylamide will present a huge breakthrough in the current state, due to the lack of comercially avalible sensor and new EU regulation on monitoring and benchmark levels for carcinogenic compound acrylamide in food industry.

Abstract

11. Novel Assay and Sensor Platforms Based on MIP Nanoparticles

Sergey Piletsky

University of Leicester; sp523@le.ac.uk

Five years ago we have made a major breakthrough in MIP technology developing solid-phase approach for preparation of soluble molecularly imprinted nanoparticles (nanoMIPs) with exquisite affinity and selectivity for their templates. The success came from combining controlled radical polymerisation with an affinity separation step performed on surface-immobilised template. This approach represents the state-of-the-art in nanoMIP synthesis: not only are soluble particles with defined size (20–200 nm) and a narrow size distribution produced in one hour, they possess subnanomolar dissociation constants for their respective targets, they can be easily functionalised with fluorescent, electrochemical or magnetic labels, and the immobilised template can be re-used. High affinity nanoMIPs were made for small molecules, proteins, membrane proteins and virus particles. The main practical niches for application of synthesised nanoMIPs are diagnostics, imaging and drug delivery. Members of our team have used nanoMIPs successfully as a replacement for antibodies in ELISA-type assays, electrochemical and optical sensors. Here we present development of novel assay and sensor platforms based on MIP nanoparticles. New MIP-based optical assays and electrochemical sensors were developed for small molecules such as drugs and pesticides and for large proteins such as pepsin, trypsin, and gluten. These assays and sensors are characterised by simple and efficient manufacturing procedure, straightforward application that does not require experienced personnel, and long operational and shelf life.

Abstract

12. WO_3 Loaded with Carbon-Based Materials as Nanocomposite NO_2 Gas Sensing

Sukon-Phanichphant [1,*], Kanittha-Inyawilert [1], Jirasak-Sukunta [1], Anurat-Wisitsoraat [2] and Chaikarn-Liewhiran [1]

[1] Chiang Mai University
[2] Thammasat University
* Correspondence: sphanichphant@gmail.com

In the present work, the effect of carbon nanotubes (CNTs) and graphene nanosheet were loaded into WO_3 nanorods matrix for a systematic study to NO_2 gas sensing. The sensing films were fabricated by spin coating and tested towards NO_2 at various temperatures ranging from 200 to 350 °C in dry air. The particle and sensing film properties were characterized by X-ray diffraction, nitrogen adsorption, electron microscopy and X-ray photoelectron spectroscopy. Gas sensing results showed that the WO_3 sensing film with the optimal graphene content of 5.0 wt% exhibited high response of 769 towards 5 ppm NO_2 at the operating temperature of 250 °C. The WO_3/graphene nanocomposite exhibits a higher sensing performance for NO_2 gas than the WO_3/CNTs at the same condition. In addition, both graphene and carbon nanotubes loaded WO_3 sensing films displayed good stability and NO_2 selectivity against various toxic and flammable gases including CH_4, H_2, H_2S, NO, C_2H_5OH and C_3H_6O.

Abstract

13. *Brettanomyces bruxellensis* Detection by Optical and Acoustic Biosensor in Comparison

Priya Vizzini * and Marisa Manzano

University of Udine

* Correspondence: furezp@hotmail.it

The main aim of this work is to compare two highly sensitive DNA biosensors developed for the purpose of detecting *Brettanomyces bruxellensis* in wine to prevent wine spoilage, the contamination of the cellar, and the consequent economic losses. Taking into account the techniques already used for this reason (analyses of wine samples), the utilization of extracted DNA, without the need of previous amplification is here proposed. Moreover, the utilization of a label free DNA probe for biosensor application is reported, as label free detection systems have high possibility of realizing more convenient bioassay. The labeling procedure can cause high background signal. Thus, according to the aim previously mentioned, the performances of a biosensor based on localized surface plasmon resonance (LSPR) phenomenon and one based on acoustic waves phenomenon such as quartz crystal microbalance (QCM) are described. The work focused on optimization of the experimental conditions and draw up of a protocol. These DNA biosensors lead to several advantages such as short analysis time, minimum liquid handling, a reduced sample volume and a multiple detection possibility.

Abstract

14. Application of FBG Sensing Technique in Monitoring the Performance of PHC pile-Cored DCM Composite Pile Foundation

Juncai Li *, Qiubin Zhang, Yijie Sun, Xiaobei Yuan and Xiaolong Hua

Nanjing Tech University

* Correspondence: 1452643191@njtech.edu.cn

The pretensioned spun high-strength concrete (PHC) pile stiffened deep cement mixing (SDCM) pile was a new developed type of composite foundation. This composite pile composes of an inner PHC pipe pile and an external DCM pile socket. It can be used to improve the performance of soft ground. In this paper, a field full-scale static load test was performed to study the load transfer mechanism of the composite pile. Fiber Bragg grating (FBG) sensing technique was used to monitor the axial stress along the pile under different loads. Based on the pile theory, the shaft friction resistance and the pile tip resistance were obtained associated with their stress distribution. The monitoring results show that the shaft friction bears most part of the load, suggesting the characteristic of friction pile. This study confirms that the FBG sensors are suitable for monitoring the performance of the novel SCDM pile, which can provide reliable basis for optimizing the composite pile foundation design and help promote its further application in engineering projects.

Abstract

15. Fiber Optic Monitoring System for Beam Induced Heating on High Energy Accelerator's Beam Pipes

Francesco Fienga [1,2,*], Zoltan Szillasi [3], Noemi Beni [2], Andrea Irace [4], Benoit Salvant [2], Wolfram Zeuner [2], Salvatore Buontempo [1,2] and Giovanni Breglio [4]

[1] Istituto Nazionale di Fisica Nucleare (INFN)—Sezione di Napoli, I-80126 Napoli, Italy
[2] European Organization for Nuclear Research (CERN), 1211 Genève, Switzerland
[3] Institute of Nuclear Research of the Hungarian Accademy of Science (ATOMKI), Debrecen, Hungary
[4] University of Napoli Federico II, Department of Electronical Engineering (DIETI), I-80125 Napoli, Italy
***** Correspondence: francesco.fienga@cern.ch

The iPipe project consists in the development of a fiber optic monitoring system, based on the Fiber Bragg Grating (FBG) technology, for thermal and structural measurements on high energy accelerator beam pipes. We instrumented the section of the Large Hadron Collider (LHC) passing through the Compact Muon Solenoid (CMS) experiment. The general aspects of the FBG sensor have been widely demonstrated during the last decade. In particular, the advantages of small size, light weight, electromagnetic immunity and radiation hardness make FBG sensors the ideal devices for several applications in harsh environment, as for monitoring purposes in high energy physics experimental facilities. The iPipe FBG temperature sensors represent an innovative solution to monitor the thermal behavior of the beam pipe. This contribution focuses on the direct measurements of the beam induced heating on the CMS beam pipe. The beam induced heating is a key effect to be studied and monitored during the operation of the LHC in order to guarantee the nominal performances of the machine. Moreover, the thermal monitoring of the different sectors of the LHC in not always a trivial task and conventional electronic sensors cannot be used in all the harsh environments represented by the various LHC elements. The iPipe monitoring system turned out to be a solid and reliable solution for the measurements of local thermal gradients along the accelerator sectors. The experimental data presented in this work represent the first direct measurement of the beam induced heating on the CMS beam pipe.

Abstract

16. Predicting the Alcohol Content during Fermentation Using Sensor Measurements and Machine Learning

Josep Escrig and Nicholas Watson *

University of Nottingham; ezzje1@nottingham.ac.uk
* Correspondence: nicholas.watson@nottingham.ac.uk

On-line monitoring of alcohol content during the fermentation of beer ensures the right development of the process and an efficient use of the equipment. One technique for monitoring fermentation is ultrasonic measurements. Ultrasonic techniques propagate high frequency sound waves through the wort during the fermentation. The propagation of ultrasound through single phase systems is dependent upon their mechanical properties such as density. In multiphase systems (e.g., a fluid with gas bubbles) the sound propagation is also affected by the size, shape, and volume of the discontinuous phase.

This paper presents an ultrasonic sensor designed to detect the reflexions of ultrasonic waves propagating through fermenting beer. In addition, a non-linear relationship was stablished between features extracted from ultrasonic signals (together with the temperature of the beer) and the alcohol content using an ensemble of recurrent artificial neural networks. This relationship could predict the alcohol content with an error of approximately 0.11%.

Abstract

17. Combinatorial Selectivity of Porphyrins Based Gas Sensors

Rosamaria Capuano [1], Alexandro Catini [1], Roberto Paolesse [2] and Corrado Di Natale [3,*]

[1] Department Electronic Engineering, University of Rome Tor Vergata
[2] Department Chemical Science and Technology; University of Rome Tor Vergata
[3] University of Rome Tor Vergata
* Correspondence: dinatale@uniroma2.it

Combinatorial selectivity is the approach adopted by nature to identify chemical cues made by unpredicted combinations of volatile compounds. The approach makes use of a limited number of different receptors (e.g., more than 300 in humans) which enables the identification of million of different odors. The efficient technological translation of this principle requires a versatile and simple method to produce sensors that, although unselective, can be designed to orient the sensitivity towards selected interaction mechanisms and molecular features. Among other possibilities, porphyrinoids offer the possibility to taylor the chemical affinity with minimal variations in the molecular structure and then in the synthesis process. In this paper, the actualization of combinatorial selectivity with porphyrinoids will be illustrated and examples of applications will be presented. As an example of application of porphyrinoids based sensor ensembles, the analysis of volatilome in-vivo and in-vitro studies both on humans and animal models will be illustrated.

Abstract

18. Detection of Triclosan in Tuned Solutions by pH and Ionic Strength Using PAH/PAZO Thin Films

Paulo M. Zagalo [1,*], Cátia Magro [2,*], João Pereira-da-Silva [1], Benachir Bouchikhi [3], Nezha el Bari [4], Paulo Ribeiro [1] and Maria Raposo [1]

[1] CEFITEC, Departmento de Física, Faculdade de Ciências e Tecnologia, Universidade Nova de Lisboa, 2829-516 Caparica, Portugal
[2] CENSE, Departamento de Ciências e Engenharia do Ambiente, Faculdade de Ciências e Tecnologia, Universidade Nova de Lisboa, 2829-516 Caparica, Portugal
[3] Sensor Electronic and Instrumentation Group, Physics Department, Faculty of Sciences, Moulay Ismaïl University, BP 11201, Zitoune, 50003 Meknes, Morocco
[4] Sensor Biotechnology Agroalimentary and Biomedical Analysis Group, Biology Department, Faculty of Sciences, Moulay Ismaïl University, BP 11201, Zitoune, 50003 Meknes, Morocco
* Correspondence: p.zagalo@campus.fct.unl.pt (P.M.Z.); c.magro@campus.fct.unl.pt (C.M.)

Triclosan is widely used in household produts and is being extensively found in water bodies waters, fish and human milk. Related to the non-regulation of this compound, there is a growing concern on presence and impact, increasing the need for reliable and effective water monitoring sensors capable of detecting these molecules. One of the main challenges in sensors' monitoring is ensure analyte effective detection in complex matrices that contain countless spurious molecules (potential interfering compounds), such as salts or even fluctuations of pH can jeopardize the analysis of a target molecule.

The purpose of this study was to assess the sensitivity of a sensor based in thin-films prepared by layer-by-layer technique using polyelectrolytes of poly(allylamine hydrochloride) (PAH) and poly[1-[4-(3-carboxy-4hydroxyphenylazo) benzene sulfonamido]-1,2-ethanediyl, sodium salt] (PAZO), absorbed onto gold interdigitated electrodes deposited on glass supports. Thin-films of PAH/PAZO ((PAH/PAZO)$_{10}$) and (PAH/PAZO)$_{10}$/PAH were prepared for TCS detection of. The detection was performed by measuring the impedance spectra of thin film when immersed in TCS aqueous solutions (10^{-5} M to 10^{-15} M concentrations). The results showed sensibility in TCS solutions with concentrations between 10^{-5} M and 10^{-8} M.

The increasing of ionic strength (adding NaCl) was also studied. Results concluded that ionic strength affects impedance spectra at higher frequencies. Additionally, the amount of TCS adsorbed on the thin-films with decreasing pH was also analyzed. The removal of TCS molecules on sensors with PAH as outer layer was higher than with PAZO.

Abstract

19. Electroactive Nanocarbon as Novel Label for DNA Analysis

Alessandra Bonanni

Nanyang Technological University, Singapore; a.bonanni@ntu.edu.sg

Electroactive nanocarbon can be defined as a carbon nanomaterial showing an intrinsic electroactivity that is due to the presence of electroactive functional groups on its surface. We use here a carbon nanomaterial as the electroactive label for the development of a low-cost and easy-to-miniaturize non-optical polymerase chain reaction (PCR). To this aim, graphene oxide nanocolloids (GONCs) were first conjugated to the DNA primers either by physical adsorption or by the formation of a covalent bond. Subsequently, GONC-modified primers were hybridized to their complementary counterpart to obtain GONC-modified double stranded DNA (GONC-dsDNA). The electrochemical signal, due to the reduction of the electrochemically reducible oxygen functionalities on GONC surface was then measured and correlated to the concertation of GONC-dsDNA. We demonstrated here the proof-of-principle of DNA quantification with an electroactive nanocarbon material as the label, which could be easily applied to the development of a cost-effective and portable device for electrochemical PCR.

Abstract

20. Experimental-Numerical Design of a Bioreactor Prototype for Cell Vibration Experiments

David Valentin [1,*], Charline Roehr [2], Alexandre Presas [1], Christian Heiss [2] and Wolfram A. Bosbach [2]

[1] Centre de Diagnòstic Industrial i Fluidodinàmica (CDIF), Universitat Politècnica de Catalunya (UPC)
[2] Laboratory for Experimental Trauma Surgery, Justus Liebig University of Giessen, Germany
* Correspondence: david.valentin@upc.edu

In this study, an apparatus for exposing cells to vibration is designed and tested experimentally and numerically. It follows our previous work [1–3] where we tested an initial simpler prototype. The objective of this research is to study the influence of different vibration patterns on in-vitro cells. Fields of interest of this study are cancer therapy and antibacterial measures. In those fields, previous research has shown a response to vibration by osteosarcoma cells and also by bacteria. The methodology presented includes a vibrating apparatus based on a disk instrumented with a piezoelectric patch. With this, the vibration amplitude and frequency are totally controlled. Over the disk surface, a petri dish is located, which contains the in-vitro cell culture. The vibration response is measured with a Laser Dopler Vibrometer (LDV) and an ultrasound sensor. Numerical models are also implemented in order to help with the prototype design and to obtain further information about the vibration shape.

Abstract

21. Monitoring the Different Stages of Industrial Cleaning Using Ultrasonic Sensors

Nicholas Watson [1,*], Josep Escrig Escrig [1], Elliot Woolley [2], Shreedhar Rangappa [2] and Alessandro Simeone [3]

[1] University of Nottingham
[2] Loughborough University
[3] Shantou University
* Correspondence: nicholas.watson@nottingham.ac.uk

Cleaning of processing equipment is one of the most important processes in the Food and Drink, Pharmaceutical and FMCG sectors as it prevents cross contamination of products and eliminates risks associated with unhygienic processing conditions. Most manufacturers use Clean-in-Place (CIP) systems which utilise a combination of temperature, time chemicals and mechanical force to clean the facilities without the requirement of human intervention or dismantling of equipment. One major problem with CIP systems is that to unsure hygienic conditions they over clean the equipment results in negative effects on a facilities productivity and environmental impact. To overcome this challenge there is a need for new technologies to monitor and therefor optimise CIP processes. This project has developed an ultrasonic sensor technique which can non-invasively monitor the internal surface fouling of pipe work in real-time. We will present experimental results demonstrating how ultrasonic measurements can be used to monitor the cleaning of different industrially relevant fouling materials.

Abstract

22. Photonic Integrated Circuit Sensor for Human Performance Monitoring †

Mikella Farrell, Justin Bickford, Pak Cho, Ellen Holthoff * and Paul Pellegrino

U.S. Army Combatant Capabilities Development Command, Army Research Laboratory,
2800 Powder Mill Road, Adelphi, MD 20783, USA
* Correspondence: ellen.l.holthoff.civ@mail.mil
† Presented at the 7th International Symposium on Sensor Science, Naples, Italy, 9–11 May 2019.

Abstract: Wearable biosensors have emerged as an advancement in the field of performance and threat monitoring in part due to the potential to overcome the limits of conventional soldier health monitoring and environmental sensing technologies. We introduce the integration of a synthetic and biomimetic xerogel polymer layer onto a photonic chip, for the selective monitoring of targeted soldier performance biomarkers. A molecularly imprinted xerogel material has been optimized for selection and capture of the human stress hormone cortisol, and proof-of-principle experiments will be discussed. This sensor can be integrated onto a wearable diagnostics platform, thus potentially providing real-time monitoring of stress, and other biomarkers, in commonly accessed fluids like sweat.

Keywords: sensor; integrated photonics; molecular imprinting; wearable

Abstract

23. Potentiometric Multisensor System for Plutonium Quantification in Spent Nuclear Fuel Reprocessing

Yulia Savosina [1], Marina Agafonova-Moroz [1], Alexander Lumpov [1], Vasily Babain [2], Andrey Legin [3] and Dmitry Kirsanov [3,*]

[1] Khlopin Radium Institute, St. Petersburg, Russia
[2] ThreeArcMining, LLC
[3] St. Petersburg State University
* Correspondence: d.kirsanov@gmail.com

Plutonium is an important component of spent nuclear fuel and it has to be recovered for further use during the reprocessing stage to ensure the safe disposal of wastes. This requires an application of appropriate analytical methods that are typically based on ICP: ICP-MS, ICPAAS/AES (mass-spectrometry, atomic absorption, atomic emission). While offering high sensitivity and selectivity these methods are characterized by long and tedious sample preparation, expensive equipment and consumables and can hardly be implemented in on-line mode, thus the results of analysis are only available several hours later after the sampling from technological line. We suggest an alternative way for plutonium quantification in process streams based on electrochemical sensors. We have demonstrated that potentiometric sensors with plasticized polymeric membranes containing various ligands suggested in liquid extraction for separation of actinides and lanthanides can provide reproducible response towards plutonium in acidic solutions. Moreover, the multisensor array based on such electrodes allows simultaneous quantification of plutonium and uranium in model technological solutions simulating spent nuclear fuel reprocessing streams. Application of chemometric tools for sensor array data processing yields the precision in actinide quantification which is sufficient for technological needs.

This study was supported by Russian Science Foundation (project #18-19-00151).

Abstract

24. Seven-Rod Dielectric Sensor for Determination of Soil Moisture in Small Volumes

Justyna Szerement [1,*], Aleksandra Woszczyk [1], Agnieszka Szypłowska [1], Marcin Kafarski [1], Arkadiusz Lewandowski [2], Andrzej Wilczek [1] and Wojciech Skierucha [1]

[1] Institute of Agrophysics, Polish Academy of Sciences, Doświadczalna 4, 20-290 Lublin, Poland
[2] Institute of Electronic Systems, Warsaw University of Technology, Nowowiejska 15/19, 00-665 Warsaw, Poland
* Correspondence: j.szerement@ipan.lublin.pl

The need for indirect, rapid and accurate moisture content measurement in soil is still under study. Existing direct laboratory methods are often expensive, time-consuming and destructive. Therefore, the development of accurate dielectric sensors working in time—(TDR) and frequency—(FDR) domain techniques over a broad frequency range is important for agricultural and industrial applications.

The aim of the study was to construct, digitally simulate and test a seven-rod probe of simplified coaxial geometry, consisting of a signal conductor surrounded by six ground ones. The probe directly measures complex dielectric permittivity spectrum and requires three calibration media: air, water and ethanol. The volume of the sensitivity zone of the tested probe was assessed basing on FEM simulations and measurements in liquids. The probe was tested in two soils, sandy loam and silt loam, with 6 water contents from air dry soil to soil saturation. The real part of dielectric permittivity related to moisture of the tested samples. The relations between the volumetric water content and the real part of dielectric permittivity (by FDR) and apparent dielectric permittivity (by TDR) were compared with the Topp's equation. The best fit to Topp's equation was observed for sandy loam. The obtained results suggested that the seven-rod probe can be used to accurately measure the dielectric permittivity spectrum in a small sample volume of about 8 cm^3 in the frequency range from 20 MHz to 200 MHz.

Abstract

25. The Contribution of Infrared Thermography in the Characterization of Glass/Epoxy Laminates through Remote Sensing of Thermal-Stress Coupled Effects

Carosena Meola *, Simone Boccardi and Giovanni Maria Carlomagno

University of Naples
* Correspondence: carmeola@unina.it

Mechanical stresses of materials are generally coupled with temperature variations and then, monitoring such variations can help gaining information about the material behavior under the applied loads. This can be accomplished with an infrared imaging device, which can be advantageously exploited to sense the thermal radiation associated with mechanical stresses and obtain a legible explicative temperature map. In the present paper, glass/epoxy is used as case study material to show as thermal signatures visualized during the load application can be decoded into information, which can contribute to the material characterization. In particular, glass/epoxy specimens are subjected to three types of tests: cantilever beam alternate bending, quasi-static bending and low velocity impact. Thermal images are acquired in time sequence during each test and after post-processed and analyzed. It is possible to get information about the damage initiation and its evolution under either quasi-static bending, or impact. In particular, a cute analysis of thermal images supply information about damage types (matrix cracks, or fibers breakage) and extension of delamination, as well of the impact duration and the time to reach peak contact force. It is also possible to well depict the harmonic cantilever beam oscillations through the associated small temperature variations.

Abstract

26. Triclosan Detection in Aqueous Environmental Matrices by Thin-Films Sensors: Impedantiometric Electronic Tongue

Cátia Magro [1,*], Paulo M Zagalo [2], João Pereira-da-Silva [2], Eduardo P Mateus [1], Alexandra B Ribeiro [1], Paulo A Ribeiro [2] and Maria Raposo [2]

[1] CENSE, Departamento de Ciências e Engenharia do Ambiente, Faculdade de Ciências e Tecnologia, Universidade Nova de Lisboa, 2829-516 Caparica, Portugal
[2] CEFITEC, Departmento de Física, Faculdade de Ciências e Tecnologia, Universidade Nova de Lisboa, 2829-516 Caparica, Portugal
* Correspondence: c.magro@campus.fct.unl.pt

The widespread use of pharmaceuticals and personal care products (PPCPs) over the years has resulted in the contamination of aquatic environments. Triclosan (TCS) is a bacteriostatic used in household items, such as toothpaste or soaps. TCS has raised health concerns that include antimicrobial resistance and endocrine disruption both to humans and biota. The actual non-regulation demands the urgency of having reliable tools that can allow the real time monitoring of these emergent compounds.

The aim of the present work was to explore the potential of using thin-films sensors based on poly(allylamine hydrochloride (PAH), graphene oxide (GO), polyethyleneimine (PEI) and polysodium 4-styrenesulfonate (PSS)—to detect different TCS concentrations (10^{-15} M to 10^{-5} M). Deionized water, Luso® a Portuguese mineral water and an effluent from a wastewater treatment plant, were used to prepare the TCS solutions which were characterized by impedance spectroscopy (1 Hz to 1 MHz, electrical resistance, electrical capacitance and loss tangent as the transducing variables at fixed frequencies, AC voltage of 25 mA) using a Solartron 1260 Impedance Analyzer.

The obtained data was analyzed by Principal Component Analysis. The results demonstrated discrimination of TCS concentrations in effluent wastewater for combination of $[PEI/PSS]_5$ or $[PEI/PSS]_{20}$. Additionally, in order to understand the thin-film behavior (desorption and/or adsorption) in the different waters and, consequently, different pHs (3, 6 and ≈8), the thin films were characterized with a UV-VIS 2101 PC Scanning spectrophotometer. These stability studies verified that thin-films molecules do not desorb or adsorb in the TCS solutions at pH ≈ 8.

Abstract

27. Urban Participative Air Quality Sensor Network for Street Scale Assessments

De Vito Saverio [1,*], Elena Esposito [1], Grazia Fattoruso [1], Fabrizio Formisano [1], Ettore Massera [1], Antonio Buonanno [1], Salvatore Fiore [1], Paolo D' Auria [2] and Girolamo Di Francia [1]

[1] ENEA
[2] ARPAC
* Correspondence: saverio.devito@enea.it

This contribution focuses on the presentation of the participative Air Quality monitoringarchitecture of the Air-Heritage Urban Innovation project. Its innovative approach grants the participation ofcitizens for enhancing air quality knowledge using validated portable and fixed multisensory nodes. Theamount of shared air quality data together with data assimilating AQ models will allow for street scalemapping of pollutants concentrations as well an improved awareness about personal exposome. In turn, thiswill significantly enhance participation in coordinated remediation policies developed through citizensinvolvement and the Air Heritage participatory data sensing approach. Preliminary results obtained for thesensor modules functional and data quality validation experiments are reported. Functional tests have shownthe capability of mobile multisensors and backend architecture to generate, collect and visualize high qualitydata for the devised goal. Validation results shows that multisensors devices have shown capable to reach challenging data quality objectives in order to act as indicative measurements systems in the EU regulatory air quality monitoring framework.

Abstract

28. Smart Lab-on-a-Chip Nanosensor Platform for Cancer Diagnostics

Larysa Baraban [1,2,*], Julian Schuett [2] and Gianaurelio Cuniberti [2]

[1] CFAED, TU Dresden, Germany
[2] TU Dresden, Institute for Materials Science and Max Bergmann Center for Biomaterials
* Correspondence: larysa.baraban@nano.tu-dresden.de

We demonstrate a nanobiosensors system combining the ultracompact detection element (around only 40 μm^2) with the machine learning concept to interpret the measured data. We use this development to detect, as a proof of concept demonstration, acute myeloid leukemia (AML) by the analysis of peripheral blood mononuclear cells. In this respect we realize an ultra-compact nanosize flow cytometer for real-time impedimetric detection and classification of subpopulations of living cells. The setup is combined with machine learning elements implemented in a data analysis software. Nanoscopic gold nanowire electrodes, integrated into a microfluidic channel, act as nanocapacitors and measure in time domain the change of the amplitude and phase of the output voltage and, thus, the electrical properties of living cells. First, we successfully perform the analysis of the purified human peripheral blood mononuclear cells (PBMCs) representing a complex pool of isolated immune cells from whole blood. Using the algorithm for automatic PBMCs analysis based on machine learning approaches, i.e., clustering and signal approximation, we further generated specific data patterns for recognition of healthy donors and AML patients.

Abstract

29. Bio-Functionalization of Graphene with a Laccase Hydrophobin Chimera

Ilaria Sorrentino [1,*], Ilaria Stanzione [1], Alessandra Piscitelli [1], Alan Le Goff [2] and Paola Giardina [1]

[1] Department of Chemical Sciences, University Federico II, Naples, Italy
[2] University Grenoble Alpes, CNRS, DCM, 38000 Grenoble, France
* Correspondence: ilaria.sorrentino@unina.it

The immobilization of enzymes on the nanomaterial surface is a challenge task in the development of novel biosensing platforms. A process of production of biofunctionalized graphene has been previously set out, using ultrasonic waves to exfoliate graphite in synergy with a fungal self-assembling adhesive protein, the class I hydrophobin Vmh2.

The properties of Vmh2 were also exploited to immobilize the laccase PoxA1b on graphene. This enzyme from *Pleurotus ostreatus* displays a high redox potential and is endowed with a remarkable stability at high temperature and at alkaline pH, thus it can be used to detect phenolic compounds in different matrices. Its genetic fusion with Vmh2 allowed the one-pot enzyme immobilization on graphene without additional purification steps. The bio-functionalization of graphene with PoxA1b-Vmh2 was achieved with the addition of the chimeric enzyme in the last step of graphite exfoliation in the presence of Vmh2. The stability and the specific activity of PoxA1b-Vmh2 on graphene confirmed that the fusion with Vmh2 improved the enzyme performances with respect to those of the enzyme alone.

The biofunctionalized graphene with the fused enzyme was deposited on Glassy Carbon Electrode (GCE) and used as working electrode for a chronoamperometric test for the revelation of catechol.

Abstract

30. Development and Characterization of an Ultra High Frequency (UHF) Love-Surface Acoustic Wave (L-SAW) Biosensor

Gina Greco *, Matteo Agostini and Marco Cecchini

NEST, Istituto Nanoscienze-CNR and Scuola Normale Superiore, Piazza San Silvestro 12, 56127 Pisa, Italy

* Correspondence: gina.greco@sns.it

The detection of low concentrations of biomarkers is of high interest in the biosensor field. Early detection and follow up of diseases with point of care (POC) devices can provide rapid diagnostic results in non-laboratory settings, reducing waiting time and costs. Surface acoustic wave (SAW) technology has been demonstrated to be extremely promising for this purpose. Love SAW, in particular, are very popular for their ability to operate in liquid media, enabling real-time detection of analytes. Love biosensors typical working frequencies range from tens of MHz to a few hundreds of MHz but it is known from literature that the limit of detection (LOC) and the sensitivity of a SAW biosensor can be enhanced by increasing its working frequency. Here we present the design, nanofabrication and characterization of an ultra-high-frequency (UHF) Love-SAW biosensor. The biosensor consists in a substrate of 36 °Y cut lithium tantalate on which 4 delay lines at the working frequency of 1 GHz are patterned. A waveguide of polymethylmethacrylate (PMMA) is deposited on the chip for Love SAW generation, and a polydimethylsiloxane (PDMS) microchannel completes the device. Sensor performance is quantitatively evaluated and discussed by measuring the kinetics of bovine serum albumin (BSA) adsorption on PMMA.

Abstract

31. Development of Rapid Immunodetection Tests of *Escherichia coli* O157: H7 and *Listeria monocytogenes* on Working Surfaces in Food Industries

Monique Lacroix [1,*], Amina Baraketi [1], Marie-Christine Etty [1], Alessandro Capo [2], Carole Fraschini [3] and Sabato D'Auria [2]

[1] INRS-Institut Armand-Frappier
[2] CNRSIBP-CNR
[3] Fp Innovation
* Correspondence: Monique.Lacroix@iaf.inrs.ca

Immuno-detection methods using a sandwich ELISA test via a biopolymer support membrane based on nanocomposite (CCG) as antibodies carrier for detecting *L. monocytogenes* and *E. coli* O157: H7 has been developed. For *L. monocytogenes*, the test was specific for the p60 protein involved in its pathogenicity. The optimisation of the Listeria enrichment broth (LEB) has permitted to increase the expression of the L. monocytogenes p60 protein and to reduce the time of detection by 50%. The CCG has allowed the capture of the p60 protein antibodies from an environmental sample inoculated with 10^2 CFU/mL of *L. monocytogenes*. The use of a mathematical model has permitted to combine enrichment and capture steps and led a better exposition of antibodies. The detection of p60 protein was done after 48 h instead of 72 h. For *E. coli* O157: H7, an enrichment medium has been optimized, ensuring an increase of the bacterial growth and of the production of the Shiga-like toxin 2. A mathematical model has permitted the optimisation of antibodies immobilisation and better detection. A 10^3 cells/mL was detected after 4 h of enrichment instead of 12 h with conventional methods.

Abstract

32. Cobalt-Dispersed Reduced Graphene Oxide Nanocomposite for the Selective Electrochemical Detection of Methyl Nicotinate

Pallab Kumar Bairagi, Arpit Goyal and Nishith Verma *

Department of Chemical Engineering, Indian Institute of Technology Kanpur, India
* Correspondence: nishith@iitk.ac.in

Tuberculosis has been one of the leading chronic diseases from the date of its identification. If there is a delay in the early detection and treatment, it may become life threatening. Methyl nicotinate (MN) is one of the four important biomarkers, whose concentration increases sharply (from zero) in human blood and sputum in the presence of 'mycobacterium tuberculosis' bacteria causing tuberculosis. Electrochemical methods can be used to accurately detect the disease. In this study we have developed a nitrogen (N)-doped phenolic polymer precursor based carbon composite that was in situ dispersed with graphene oxide and Cobalt (Co)-nanoparticles, as the sensor electrode (Co-rGO/Pc). Co-nanoparticles were used as the recognition element for the MN molecules. The prepared electrode materials were characterized using SEM, EDS, EIS and CV. Tested with differential pulse voltammetry, Co-rGO/Pc showed its applicability (RSD 6%) over 0.05–15 ppm MN concentration (S/N ratio = 3) with high sensitivity, and a good selectivity. The present method and materials can also be used for the development of sensors for the other biomarkers.

Abstract

33. Identification of Epitopes and Molecular Markers Using Molecular Imprinting

Elena Piletska * and Sergey Piletsky

Department of Chemistry, University of Leicester, UK

* Correspondence: ep219@le.ac.uk

The knowledge of protein epitopes is of paramount importance for the design of new drugs and vaccines, and for the development of the assays and sensors used for protein analysis. Despite big efforts of the research community, the identification of protein epitopes remains challenging. One of the common methods used in analysis of cell-surface protein expression, such as FACScan, is time-consuming, expensive and difficult to implement in clinical setting. In addition, it is entirely based on the availability of antibodies for pre-selected targets and cannot be applied if targets are unknown.

We would like to present a technique for epitope mapping using molecular imprinting, which was developed by our Leicester Biotechnology Group. Our method does not rely on the availability of antibodies, it is robust, quick (2 weeks) and economically effective as compared with existing protocols. It identifies sought-after linear epitopes, which could be used either for preparation of the synthetic binders, such as molecularly imprinted polymer nanoparticles for their application as recognition elements in sensors and assays, or for raising the natural antibodies. We believe that the developed technology is an effective tool for fundamental research on structure-based drug discovery, study of protein-protein and protein-ligand interactions and identification of cell-surface biomarkers. The presented case studies will include the epitope mapping of the individual proteins, such as acetylcholine esterase (AChE), and whole cells, particularly cancer and senescent cells.

Abstract

34. Intracellular Sensing by Molecular Beacons Coupled to Nanoparticles in Human Cancer Cells

Barbara Adinolfi [1], Sara Tombelli [1,*], Mario Pellegrino [2], Cosimo Trono [1], Ambra Giannetti [1], Claudio Domenici [3], Greta Varchi [4], Giovanna Sotgiu [4], Marco Ballestri [4] and Francesco Baldini [1]

[1] Istituto di Fisica Applicata Nello Carrara—CNR
[2] Istituto Nazionale di Ottica—CNR
[3] Istituto di Fisiologia Clinica—CNR
[4] Istituto per la Sintesi Organica e la Fotoreattività—CNR
***** Correspondence: s.tombelli@ifac.cnr.it

The idea developed in this work is to use biocompatible polymethylmethacrylate nanoparticles (PMMA-NPs) as carrier of a molecular beacon (MB) for sensing a specific mRNA in cancer cells. MBs are oligonucleotide sequences generating a fluorescent signal when they hybridize with their target. They constitute potential theranostic agents as they can act at the same time as sensors, able to detect endogenous nucleic acids, and as drug, by silencing the target mRNA. As delivery vehicles of anticancer drugs, NPs offer numerous advantages over conventional drug delivery approaches, such as the possibility of multiple functionalization for improving the imaging, diagnosis and targeted therapy. In particular, the PMMA-NPs used in this study consist of a hydrophobic PMMA core covalently functionalized with fluorescein and an external hydrophilic shell decorated with primary amine groups and quaternary ammonium salts.

The characterization of the MB in solution revealed a good specificity and sensitivity, confirmed also after its adsorption onto the PMMA-NPs. The results obtained by confocal microscopy in cancer cells, demonstrated that the PMMA-NPs efficiently promote the MB internalization generating a specific fluorescent signal in the presence of survivin mRNA expression, paving the way to a semi-quantitative real time sensing for protein expression. Intracellular localization and fate of the NPs and of the MB was also investigated: a cellular release of nanoparticles in the culture medium was demonstrated together with the correct localization of the MB fluorescence in proximity of its target mRNA.

Abstract

35. Microgels for High Sensitive, Direct and Multiplexed miRNAs Optical Sensing

Tania Mariastella Caputo [1], Edmondo Battista [2], Paolo A Netti [1] and Filippo Causa [2,*]

[1] Center for Advanced Biomaterials for Healthcare@CRIB, Istituto Italiano di Tecnologia (IIT)
[2] Interdisciplinary Research Centre on Biomaterials (CRIB), Università degli Studi di Napoli "Federico II"
* Correspondence: causa@unina.it

We report examples of microgels as biosensor for ultra-high sensitive analytical determination of oligonucleotide biomarkers. Assay is based on optical read-out from single-microgel. In particular, fluorescence turn-on occurs upon target capture due to proprietary probe conjugated in the microgel. Due to antifouling properties of microgels the sensing can occurs directly in complex fluids such as serum, plasma or milk without purification or amplifications step.

The use of the microgel allows to a 10^5-fold enhancement in sensitivity (2.6 fM) compared to not conjugated probes (172 pM) in miRNA detection. The use of microgels leads to a simple and absolute quantification in serum extracts without target amplification steps, internal normalization, or primer optimization with a higher precision than qRT-PCR. Spectrally encoded microgels also permit multiplex detection for a panel of miRNA targets or viral (HIV, SARS and HCV) oligonucleotides. As based on single-microgel read out, the performances of optical detection in terms of dynamic working range and limit of detection can be finely tuned by playing with the number of microgels per tube (scalable sensitivity). For detection of hcmv-microRNAs The LOD of the assay can be indeed tuned in the range from 39.1 fM to 156 aM. Microgels can also flow in microfluidic devices for an on-line fluorescence read-out.

References

1. Battista, E.; et al. *Gels* **2017**.
2. Battista, E.; et al. *Pol. Int.* **2016**.
3. Causa, F.; et al. *J. Am. Chem. Soc.* **2015**.
4. Aliberti, A.; et al. *Analyst* **2016**.
5. Caputo, T.M.; et al. *Analyst* **2019**.
6. Dannhauser, D.; et al. *Biomicrofluidics* **2016**.

Abstract

36. Smart Thermometers Functionalized with High Affinity Nanoparticles for the Thermal Detection of Cardiac Biomarkers

Robert Crapnell

Manchester Metropolitan University; R.Crapnell@mmu.ac.uk

Molecularly Imprinted Polymer nanoparticles (nanoMIPs) are synthetic mimics of antibodies, but possess the advantage of low-cost, straightforward production and superior and thermal stability compared to their natural counterparts. They can be tailored to their targets and used for detection of a range of analytes, including small molecules and proteins [1,2]. Soluble ST2 and Heart Fatty Acid Binding Protein (H-FABP) are two proteins that have been explored as possible biomarkers for myocardial infarction. The nanoMIPs are synthesized, dispersed in water and subsequently dip-coated onto the surface of a thermocouple inside a flow cell. This flow cell is coupled to a home-made thermocouple device, which accurately measures the changes in thermal resistance at the solid-liquid interface of the thermocouple and the sample. As the concentration of the target is increased inside the flow cell, binding between the biomarkers and nanoMIPs occurs. This produces a measurable change in the thermal resistance as an increasingly insulating layer is formed on the outside of the thermocouple. Clinically relevant levels of detection in the sub-nanomolar range were achieved for both biomarkers using this methodology. This is the first time this sensing platform has been utilised in an array format for the detection of multiple analytes in a single flow cell. This system shows great potential for the use as a point-of-care device for the real-time monitoring of cardiac biomarkers in patient care.

Abstract

37. The Pyro-Electrohydrodynamic Jet Accumulation: A New Tool for High Sensitive Detection of Low Abundant Biomolecules

Simonetta Grilli [1,*], Romina Rega [1], Martina Mugnano [1], Emilia Oleandro [1,2], Pierangelo Orlandro [1], Veronica Vespini [1], Sara Coppola [1], Emanuela Mazzon [3] and Pietro Ferraro [1]

[1] CNR-ISASI, Institute of Applied Sciences and Intelligent Systems, Via Campi Flegrei 34, 80078 Pozzuoli, Italy
[2] Department of Mathematics and Physics, University of Campania "L. Vanvitelli", Viale Lincoln 5, 81100 Caserta, Italy
[3] IRCCS Centre for Neuroscience Bonino-Pulejo, Strada Statale 113, 98124 Messina, Italy
* Correspondence: s.grilli@isasi.cnr.it

Low abundant biomolecules are often encountered in biomedical and diagnostic applications when highly diluted biomarkers have to be detected and quantified in peripheral human fluids (e.g., plasma; urine; etc.) at the early stage of a disease. These biomarkers usually correspond to specific proteins produced by the organism and put in circulation. The common clinical analyses make use of immunoreactions as gold standard procedures for detecting such protein-based biomarkers (e.g., ELISA; sandwiched ELISA; etc.). Even though these procedures are generally reliable and robust, still their limit of detection (LOD) is critical in all of those applications where the early stage disease produces low abundant biomarkers, at concentrations below 1pM. Here we present an innovative technology that we call "pyro-electrohydrodynamic jet (p-jet) accumulation" which proposes a completely new paradigm in biomarker detection. An electric field generated pyroelectrically is able to concentrate the biomolecules into very little volumes of reactions in order to improve significantly the LOD typical of ELISA-based techniques.

Abstract

38. Transdermal Microneedle Array-Based Biosensor for Real Time Simultaneous Lactate and Glucose Monitoring

Riccarda Antiochia

Sapienza University of Rome; riccarda.antiochia@uniroma1.it

Microneedle arrays for minimally invasive continuous sensing in the dermal interstitial fluid (ISF) have been demonstrated in both amperometric and potentiometric modes, however there are no publication where microneedle arrays have been shown to function as second generation biosensors.

Here we report the first mediated pain free microneedle-based biosensor array for the continuous and simultaneous monitoring of lactate and glucose in artificial interstitial fluid (ISF). The gold surface of the microneedles has been modified by electrodeposition of Au-multiwalled carbon nanotubes (MWCNTs) and successively by electropolymerization of the redox mediator, methylene blue (MB). Functionalization of the Au-MWCNTs/polyMB platform with the lactate oxidase (LOX) enzyme (working electrode 1) and with the FAD-Glucose dehydrogenase (FADGDH) enzyme (working electrode 2) enabled the continuous monitoring of lactate and glucose in the artificial ISF. The lactate biosensor exhibited a high sensitivity (797.4 ± 38.1 mA cm^{-2} mM^{-1}), a good linear range (10–100 μM) with a detection limit of 3 μM. The performances of the glucose biosensor were also good with a sensitivity of 405.2 ± 24.1 mA cm^{-2} mM^{-1}, a linear range between 0.05 and 5 mM and a detection limit of 7 μM. The biosensor array was tested to detect the amount of lactate generated after 100 min of cycling exercise (12 mM) and of glucose after a normal meal for a healthy patient (10 mM).The results reveal that the new microneedles-based biosensor array holds interesting promise for the development of wearable real-time monitoring devices to be used in sport medicine and clinical care.

Abstract

39. Pushing of Acoustic and Thermal Noises in Magnetoelectric Sensors Based on Bidomain Lithium Niobate

Andrei Turutin [1,2,*], João Vidal [3], Ilya Kubasov [4], Alexander Kislyuk [4], Dmitry Kiselev [4], Mikhail Malinkovich [4], Yuriy Parkhomenko [4], Svetlana Kobeleva [4], Andrei Kholkin [4] and Nikolai Sobolev [4]

[1] National University of Science and Technology MISiS
[2] Universidade de Aveiro
[3] Department of Physics and CICECO—Aveiro Institute of Materials, University of Aveiro, 3810-193 Aveiro, Portugal
[4] National University of Science and Technology MISiS, 119049 Moscow, Russia
* Correspondence: aturutin92@gmail.com

This study reports the creation of a highly sensitive, low-frequency magnetic field sensor based on a composite multiferroic consisting of a bidomain lithium niobate/metglas laminate shaped in form of a tuning fork. An efficient suppression of acoustic and thermal noises in the measurements of AC magnetic fields has been achieved. As a piezoelectric component we used a y + 128°-cut lithium niobate single crystal. A metglas foil (serving as a magnetostrictive component) was asymmetrically bonded to each tine of the tuning fork. The sensor demonstrated a 6.7 times increase of the sensitivity to magnetic fields as compared to a single-plate magnetoelectric (ME) sensor: the magnetic field detection limit was enhanced from 20 pT to 3 pT at a frequency of ca. 318 Hz, without any additional shielding from external noises. The advantages of the ME sensors based on bidomain lithium niobate over those based on PZT or PMN-PT are a much higher thermal and chemical stability, non-hysteretic piezoelectric effect, large resistance to creep and ageing effects, lead-free nature and simple and cheap fabrication process. Ultimately, the tuning-fork ME sensors based on bidomain lithium niobate single crystals might be used in low frequency, ultra-sensitive, cheap and high-temperature magnetic field sensors for biomedical or space applications.

Abstract

40. Low-Cost MEMS Accelerometers for Tilt Measurement: Thermal Analysis, Compensation and Application

Giuseppe Ruzza *, Luigi Guerriero, Paola Revellino and Francesco Maria Guadagno

Department of Science and Technology, University of Sannio, 82100 Benevento, Italy

* Correspondence: giuseppe.ruzza@unisannio.it

Low-cost MEMS accelerometers have a wide range of application in consumer electronics and are being increasingly used for geotechnical applications like infrastructures and landslides monitoring. Although low-cost MEMS accelerometers have the potential to be used in a number of tilt-based monitoring applications, they have the disadvantage of being very sensitive to temperature variation (thermal drift). On this basis, we analyze the thermal behavior of a low-cost sensor in the range -10 to +45 °C in order to provide a simple compensation strategy to mitigate this problem. For sensor analysis, we have developed an automatic miniaturized thermal chamber that allow to simulate the both temperature variation at different sensor inclinations. The obtained raw data were used to construct low degree polynomial equations that, by relating the measurement error induced by thermal drift (i.e., acceleration residuals) to temperature and inclination (of each specific axis), can be used for thermal compensation of MEMS. To validate our compensation strategy, we performed a laboratory test and evaluated the compensation performance by calculating RMS errors before and after correction. After compensation, the RMS errors calculated for both the X and Y axes decreased by 96%, indicating the potential of using a simple set of equations to solve common drawbacks that currently make low-cost MEMS sensors unsuitable for tilt-based monitoring applications. Additionally, we made a field test to evaluate the applicability of the system to landslide monitoring. Our test indicate the potential of our monitoring system to work in real environmental conditions.

Abstract

41. Novel Sensing Technique for Non-Destructive and Non-Contact Monitoring of the Composites

Paula Corte-Leon [1], Aleksandra Allue [2], Koldo Gondra [2], Valentina Zhukova [1,3], Mihail Ipatov [1,3], Juan Maria Blanco [3] and Arcady Zhukov [1,3,4,*]

[1] Dpto. Fisica de Materiales, Fac. Quimicas, UPV/EHU, 20018 San Sebastian, Spain
[2] Gaiker Technological Centre, 48170 Zamudio, Spain
[3] Dpto. de Fisica Aplicada, EUPDS, UPV/EHU, 20018 San Sebastian, Spain
[4] IKERBASQUE, Basque Foundation for Science, 48011 Bilbao, Spain
***** Correspondence: arkadi.joukov@ehu.es

The real time non-destructive monitoring of stresses and temperature is one of the most demanded solutions in the field of sensor technologies. Recently a novel method for non-destructive monitoring utilizing ferromagnetic microwire inclusions is proposed [1]. The glass-coated microwires can provide new functionalities such as improved mechanical and corrosive properties, adherence with polymeric matrices and biocompatibility [2].

In the present paper a novel sensing technique for non-destructive and non-contact monitoring of the composites utilizing ferromagnetic glass-coated microwire inclusions with magnetic properties sensitive to tensile stress and temperature is proposed. We provide in-situ studies of the evolution of the hysteresis loop of arrays consisting of Co- and Fe-rich microwires during the composites matrix polymerization. We observed remarkable change of the hysteresis loops upon matrix polymerization: remarkable coercivity change and transformation of linear hysteresis loop to rectangular or from rectangular to linear for arrays with Co-rich and Re-rich microwires respectively. Observed dependencies are discussed considering variation of temperature and stresses during the thermoset matrix polymerization and their influence on magnetic properties of glass-coated microwires.

References

1. Olivera, M.; González, J.; Fuente, V.; Varga, R.; Zhukov, A.; Anaya, J.J. *Sensors* **2014**, *14*, 19963.
2. Churyukanova, S.; Kaloshkin, E.; Shuvaeva, A.; Stepashkin, M.; Zhdanova, A.; Aronin, O.; Aksenov, P.; Arakelov, V.; Zhukova, A. *J. Alloys Compd.* **2018**, *748*, 199.

Abstract

42. Printed Pressure Sensor for Medical Devices: An Example for Tracheal Intubation Monitoring

Nicolas Glaser [1,*], Frédéric Zanella [1] and Thomas Erb [2]

[1] CSEM SA
[2] Childrens Hospital University of Basel (UKBB)
* Correspondence: nicolas.glaser@csem.ch

An ultra-thin printed pressure sensor was developed on a flexible foil. Such a printed sensor can be produced for less than 2 EUR as a smart add-on on medical devices. Going beyond state-of-the-art printed force sensors, we developed a sensor able to measure gas pressure with a minimum relative dynamic range of −67 mbar to 133 mbar. By means of combining large area micro structuring with precision printing technology a sensor with high sensitivity was achieved. The sensor was mounted on an intubation tubus and was characterized with an artificial lung model. We report a measurement accuracy of 0.6 mbar and a measurement rate >20 Hz to record respiration cycles with high precision.

The sensor-equipped tubus will allow an airway pressure measurement directly in the trachea. This will improve the safety of artificial ventilation during anesthesia and intensive care situation. Indeed the optimal control of the respirator can be adjusted on actual pressures in the trachea rather than estimates obtained from the pressures measured at the respirator level (the present practice).

Abstract

43. Wearable Piezoelectric Sensor Technologies for Health Monitoring

Massimo De Vittorio [1,2]

[1] Center for Biomolecular Nanotechnologies, Istituto Italiano di Tecnologia, Arnesano (LE), Italy; Massimo.DeVittorio@iit.it

[2] Dipartimento di Ingegneria dell'Innovazione, Università del Salento, Lecce, Italy

---

The combination of micro- and nano-technologies with micro-mechanic, photonic, electronic and (bio)chemical approaches is producing completely new, compact and effective tools for diagnostics and therapeutics, which can be disposable, wearable, implantable or tattooable. These new technologies are opening the way to closed loop theranostics, i.e., device integrating advanced sensing and diagnostic capabilities and therapeutic response. In order to enable these new class of transducers for continuous and real time health monitoring, ultrathin and compliant non-intrusive smart technologies are required.

In this talk piezoelectric body sensors based on biocompatible, ultra-thin and flexible Aluminum Nitride (AlN) will be discussed. The sensors can be conformally wrapped around any curved surface, including skin, organs and prosthesis, thanks to their very thin and flexible polymeric substrate. The extreme compliance and flexibility make the transducers effective in producing charges and signals also from imperceptible mechanical movements, such as the blood flow in arteries under the skin. It will be shown that piezoelectric wearable and implantable technologies can be successfully applied for both sensing and energy harvesting on the human body for self-powered body sensors and for the internet of healthy things (IoHT).

Abstract

44. Optical Feedback Interferometry with THz Quantum-Cascade Lasers: Progress in THz Sensing and Imaging

Dragan Indjin

School of Electronic and Electrical Engineering, University of Leeds, Leeds LS2 9JT, UK; d.indjin@leeds.ac.uk

---

Terahertz (THz) quantum cascade lasers (QCLs) are compact sources of radiation in the 1–5 THz range with significant potential for applications in sensing, imaging and material analysis. Laser feedback interferometry (LFI) with THz QCLs is a technique utilizing the sensitivity of the QCL to the radiation reflected back into the laser cavity from an external target. The work will discuss modelling techniques and explore the novel applications of LFI in THz material analysis, sensing and bio-medical imaging. LFI with THz QCLs exploits the interferometric nature of optical feedback in a THz QCL to create a homodyning THz transceiver operating in confocal configuration. Most THz LFI systems to date have employed THz QCLs operating in the cw regime at cryogenic temperatures. However, THz QCLs have been demonstrated with peak output powers in pulsed regime exceeding 1 W and operating at temperatures as high as 200 K. Developing technologies and techniques for pulsed THz QCL LFI is therefore an important objective for elevated temperature applications. In this work we will also introduce the concept and technical realistaion of pulsed THz QCL LFI whereby the frequency sweep is also generated by the transient in laser temperature, not only by the current modulation.

Abstract

45. Optical Fiber Sensors in Asphalt for Smart Cities Traffic Monitoring

Mikel Bravo Acha [1,*], Daniel Leandro [1], Ana Bravo-Acha [2], Manuel Bravo-Navas [3], Jose Ramón Mitxelena [4], Jose Javier Martinez-Mazo [4], Elena Camarero [5] and Manuel López-Amo [1]

[1] Departamento de Ingeniería Eléctrica y Electrónica, Universidad Pública de Navarra
[2] Asfaltos y Construcciones del Baztán S.A.
[3] Eurocontratas S.A.
[4] Obysur S.L.
[5] Ayuntamiento de Pamplona, Servicio de Obras del Área de Conservación Urbana y Proyectos
* Correspondence: mikel.bravo.acha@usherbrooke.ca

Road transportation forms a backbone of modern cities but associated with this there are traffic congestion, air pollution, accidents and other effects. Therefore, a tremendous amount of effort has been made by all levels of authorities and tiers of government with an aim to minimize these issues. It is essential to ensure that the key transportation infrastructures such as roads, rail tracks, tunnels and bridges, are able to provide the most efficient and safe service to the public. Therefore, in this contribution we present a novel optical fiber sensor system for traffic monitoring in Smart Cities and installed in asphalt structures. By using fiber Bragg grating sensors technology, this system is capable to measure traffic flow, speed, weight estimation and pavement degradation. Moreover, the proper operation of the system has been proved 2.5 years after the installation in a metropolitan road. This shows the robustness of the system and its applicability in mid/long-term traffic monitoring.

Abstract

46. Paths for Optical Sensing

José Luís Santos

Physics and Astronomy Department, Faculty of Sciences, University of Porto, Portugal; josantos@fc.up.pt

Optical sensing has for long been associated with leading-edge performance and recent developments indicate this trend will continue. Progresses both at the level of well-established optical technologies and on the uncovered of fundamental optical science with direct impact on sensing and measurement justifies such statement. Here it is presented a glimpse of those progresses, assessing in particular their impact when the sensing platform is the optical fiber. It starts with the identification of the main features of optical sensing and the characteristics that positively differentiate this sensing technology comparatively with others, particularly those that are electrical based. Then, it is emphasized the potential of the combination *plasmonics and optical sensing*, mainly when it is enhanced by the immense range of possibilities opened through the access to the metamaterials world. The final section delivers some inputs on the fascinating new world of optical sensing in the realm of quantum mechanics, where truly qualitatively novel possibilities for measurement and sensing stand for discovery.

Abstract

47. A Rugged Fiber Optic Pressure Sensor for Underground Water Level Monitoring

Luca Palmieri [1,*], Luca Schenato [2], Marco Calabrese [1], Alessandro Pasuto [2] and Andrea Galtarossa [1]

[1] Department of Information Engineering, University of Padova, Italy
[2] Research Institute for Hydro-geological Protection, CNR, Italy
* Correspondence: luca.palmieri@dei.unipd.it

Pressure sensors have many fields of application, ranging from environmental monitoring to the oil and gas industry. Different fiber optic sensors have been proposed for pressure measurement, but either they have small sensitivity, and hence are befitted for large pressure ranges, or they are based on interferometry, and hence require rather expensive laser sources. In this work, we present a rugged FBG sensor prototype capable of measuring underground water level with high sensitivity. The sensor exploits a 3D-printed highly-efficient mechanical transducer that converts external pressure in longitudinal strain along the fiber. The intrinsic temperature cross-sensitivity is compensated by the additional FBG embedded in the sensor. The structure is enclosed in an aluminum alloy case to withstand harsh environments and installation procedures. Pressure and temperature sensitivities of the sensor are about 20 pm/(cm H_2O) and 17 pm/°C, respectively. The sensor has been designed to monitor the stability of dikes and embankments, by measuring the underground water level at their foot to detect anomalous filtration.

Abstract

48. Distributed Strain Measurement Using Power-Based Brillouin Sensor with Three Folded Dynamic Range

Heeyoung Lee *, Kohei Noda, Yosuke Mizuno and Kentaro Nakamura

Tokyo Institute of Technology

* Correspondence: hylee@sonic.pi.titech.ac.jp

Slope-assisted (SA-) Brillouin optical correlation-domain reflectometry (BOCDR) is a newly developed structural health monitoring system for measuring strain and temperature distributions along the sensing fiber. Since the first proposal of SA-BOCDR, it has been extensively studied because it is the only scheme with single-end accessibility, high spatial resolution, and high measurement speed. However, one major drawback of SA-BOCDR is its limited strain dynamic range due to the unique bell-shaped noise floor in the Brillouin gain spectrum peculiar to correlation-domain techniques. To overcome this drawback, in this work, we investigate a trade-off relation between the strain dynamic range and spatial resolution in SA-BOCDR and show that, by intentionally lowering the spatial resolution of the system, we can achieve strain dynamic range that is three times wider than the previously reported value. We believe that this achievement will be of great use in large-strain sensing applications based on SA-BOCDR in the near future.

Abstract

49. Opto-Mechanical Lab-on-Fiber Accelerometers

Marco Pisco [1], Francesco Bruno [1], Danilo Galluzzo [2], Lucia Nardone [2], Grzegorz Gruca [3], Niek Rijnveld [3], Francesca Bianco [2], Antonello Cutolo [1] and Andrea Cusano [1,*]

[1] University of Sannio, Optoelectronics Group - Department of Engineering
[2] Istituto Nazionale di Geofisica e Vulcanologia, Osservatorio Vesuviano
[3] OPTICS11
* Correspondence: a.cusano@unisannio.it

We designed and developed Lab on Fiber (LOF) accelerometers based on micro-opto-mechanical cavities on the optical fiber tip for vibration monitoring at specific frequency ranges. We realized a LOF sensor for seismic monitoring, composed of a micro-opto-mechanical cavity on the fiber tip, forming an extrinsic Fabry-Pérot cavity with the fibre end facet. The micromechanical structure, featuring a dual-beam cantilever with a proof mass, was designed to exhibit competitive performance with commercial seismic accelerometers. The sensor response was first characterized in laboratory. To demonstrate the sensor capability to operate in a realistic seismic surveillance system, the developed sensors were continuously used in combination with a commercial seismic sensing network. During the trial, the LOF sensor accurately sensed and registered the ground acceleration associated with the seismic sequence that struck central Italy on 30 October 2016. The optical seismic data were compared. The comparison, with traditional sensors incorporated into geophysical networks, verified the fidelity of the optical sensors in seismic wave detection, indicating their suitability as a viable alternative for a novel class of seismic sensors.

Also, cantilever-based accelerometers have been fabricated with different geometrical features from previous one. This LOF accelerometer, with a resonance at 15 kHz, exhibited a sensitivity of about 0.2 nm/(m/s^2) on a 3dB-bandwidth of 5 kHz with a resolution of 100 μg/(Hz)$^{1/2}$. The performance highlighted the potentiality of this technology to create a novel class of labs on fiber based on the integration of micro-opto-mechanical structures with the optical fibers.

Abstract

50. Enhanced IR-Based Optical Sensing of Phosphates in Aqueous Environment

Evert Jonathan van den Ham *, Ahmed Deniz Benli, Javier Núñez and Arjen Boersma

TNO Materials Solutions, Hi-Tech Campus 25, 5656 AE Eindhoven, The Netherlands

* Correspondence: jonathan.vandenham@tno.nl

In order to monitor and control phosphate accumulation in the environment, fast, low-cost and reversible sensing of phosphates is required. Up till now, this combination proved to be major a challenge, partly due to the fact that phosphates tend to bind to other matter, therefore requiring low detection limits to estimate the local phosphate accumulation [1].

In this study, low-cost and scalable methods were used to establish the desired materials combination to compile the sensor. This resulted in a reversible, IR-based optical sensor with a proven detection limit down to 0.3 $\mu g \cdot g^{-1}$, with a response time within the order of minutes. Hence, the innovative combination of materials led to the absorption bands amplification of over 100 times. In view of applications, sensing was shown both in static and dynamic (flow) aqueous environment. In addition, selectivity with respect to other anions such as nitrates or sulphates was also shown.

The combination of fast, reversible, selective and low-cost sensing with low detection limits is considered to be of great importance to monitor and improve the water quality for industrial and agricultural areas. As a follow up, further development is required to establish miniaturization and further reduce the cost of phosphate sensing.

Reference

1. Mekonnen, M.M.; et al. *Water Source Res.* **2018**, *54*, 345–358.

Abstract

51. Plasmonic Platform in Plastic Optical Fibers Combined with Molecularly Imprinted Nanogels to Sense Ultralow Protein Concentrations

Nunzio Cennamo [1], Roberta Tatti [2], Maria Pesavento [3], Luigi Zeni [1] and Alessandra Maria Bossi [2,*]

[1] Department of Industrial and Information Engineering, University of Campania L. Vanvitelli, Italy
[2] Dipartimento di Biotecnologie, Università di Verona
[3] Department of Chemistry, University of Pavia, Pavia, Italy
* Correspondence: alessandramaria.bossi@univr.it

Molecularly imprinted polymers (MIPs) are a class of tailor-made biomimetic materials, prepared by template assisted synthesis. Their polymerization in confined conditions allows the preparation of nanosized MIPs (nanoMIPs) of controlled and homogeneous dimensions, higher accessibility of the binding sites, low number of binding sites per particle, in similarity to natural receptors. Being characterized by the robustness of the polymeric materials but by recognition properties alike antibodies, nanoMIPs are promising recognition elements for sensors.

Aim of the work was to combine the nanoMIPs to a plasmonic sensor in plastic optical fibers (POFs) for targeted protein analysis.

Acrylamido-based nanoMIPs, suitable to recognize human serum transferrin, marker of inflammation and iron metabolism, were prepared by precipitation polymerization; the polymerization composition was optimized; nanoMIPs were physically characterized by microscopic analysis and by dynamic light scattering; their recognition properties were studied by isothermal nanocalorimetry. The POF sputtered with a nanolayer of gold was coupled to the nanoMIP by EDC/NHS chemistry. The sensor performance was studied with model solutions.

The nanoMIPs were swellable nanomaterial of about 25 nm in diameter that exhibited selectivity towards transferrin. The chemical coupling of nanoMIPs to the POF platform was optimized to form a quasi-monolayer sensing surface. The response of the nanoMIP/POF to the target protein was studied and showed a Kd = 65 fmol/L with a LOD = 510 attomol/L. The nanoMIP/POF selectively bound transferrin when tested with competitor proteins. Results demonstrated the nanoMIP/POF as a quasi-single molecule probe with ultra-low sensitivity for the target protein.

Abstract

52. Measurement of Viscoelasticity of Sodium Alginate by Fibre Bragg Grating

Leonardo Binetti *, Alicja Stankiewicz and Lourdes Shanika Alwis

Edinburgh Napier University

* Correspondence: l.binetti@napier.ac.uk

The measurement of rheological behaviour of sodium alginate (SA) is extremely important in the food industry to design optimised product and ensure stable flows. Sensors used currently for the purpose are bulky, expensive and requires a considerable amount of material, which after measurement, would be wasted. A novel sensor for measuring viscoelastic properties of SA in distilled water of concentration 1.0–3.0 *w*/*w*% has been tested at room temperature. The idea is to optimise the amount of material used while providing a more accurate scheme of measurement. The system proposed will substitute the mechanical Maxwell method for measuring viscoelasticity of polymers, with a mechano-optic sensor. The sensor used in this work is an FBG (Fibre Bragg Grating) inscribed onto a photosensitive fibre (PS 1250/1500). A linear response was achieved as the concentration of SA increases, with a sensitivity of (2.7 ± 0.1) (nm·s)/(*w*/*w*%) and R^2 is of 0.992. The FWHM increases linearly with a slope of (33.2 ± 5.8) (s)/(*w*/*w*%) in response to variations in concentration.

Abstract

53. POF Sensors and Applications

Lúcia Bilro [1,*], Ricardo Oliveira [1], Filipa Sequeira [1,2], Daniel Duarte [1,2] and Rogério Nogueira [1]

[1] Instituto de Telecomunicações, Aveiro
[2] Physics Department, University of Aveiro
* Correspondence: lucia.bilro@av.it.pt

Several methodologies can be used as fiber sensing that exploit the properties of light and its interaction with the surrounding medium. Variations of intensity, evanescent field absorbance, wavelength shifts, interferometry pattern changes, plasmon resonance and polarimetry interaction are some of the physical phenomena that is possible to use with POF as a sensor and that were researched and developed by the scientific community working in this field. The advancements leaded to the possibility to measure, directly and indirectly, a wide range of fundamental properties such as refractive index, temperature, humidity, strain, pressure, bending, color, turbidity, etc. To accomplish this, several arrangements with or without morphology and chemical modification to the POF were tested as transducers in variety setups. These are the cases of bending, polishing, etching, drilling, tapering, photopolymerization, thin film deposition, etc.In this talk, a broad view of some of the published and most used techniques and schemes for sensing with POF will be presented. These were/are the result of the collaboration with several research groups on the scope of different financed research projects.

Abstract

54. Three Lobes Plastic Optical Fiber Bending and Rotation Sensor

Demetrio Sartiano [1,*], Salvador Sales [1] and Elena Torres Roca [2]

[1] Universitat Politecnica de Valencia
[2] Textile Research Institute (AITEX)
* Correspondence: desar@teleco.upv.es

In this work a multiparameter plastic optical fiber (POF) sensor is presented. A three lobes POF consisting of polymethylmethacrylate (PMMA) core and a fluorinated polymer for the cladding was fabricated. The aim is to use a plastic fiber with non-circular shape to implement a bending direction and rotation sensor. Extrusion and a custom shaping die were employed to fabricate the PMMA filament. The extrusion process was optimized to reach as low optical losses as possible. The mode confinement in the plastic filament obtained with the extrusion process was simulated, and the effect of bending evaluated. The POF sensor is interrogated in transmission using an LED as light source and a charge-coupled device (CCD) to capture the light intensity distribution inside the core, and then analyze the changes when a bending or a rotation is applied. The circular asymmetry of the fabricated fiber permits to retrieve the direction of bending in space and the rotation angle, processing the images with intensity-based image registration algorithm.

Abstract

55. Electrokinetic Assembly of Gold Nanoparticles into Sensitive and Functionalizable Surface-Enhanced Raman Scattering-Based Sensors

Hannah Dies *, Danielle Lilly Nicholls, Carlos Escobedo and Aristides Docoslis

Department of Chemical Engineering, Queen's University

* Correspondence: 9hed@queensu.ca

Surface-enhanced Raman scattering (SERS) can enable ultrasensitive detection of chemical and biological analytes in fluid samples. However, a major obstacle to its application arises from difficulty in producing the noble metal nanostructures required for SERS-active surfaces. Notably, gold nanostructures have the benefits of being inert, enabling longer shelf life and reduced oxidation, and easily functionalizable, enabling attachment of biological molecules for specific biosensing. Here, we present a method for producing gold SERS substrates via the alternating current electrokinetic assembly of gold nanoparticles from a colloidal suspension into two main (frequency-dependent) structures: (1) nanowires that form along electric field lines, and (2) "nanotrees", that branch and create extended surfaces for sensing. This study identifies specific electrokinetic regimes that promote one type of assembly over another. We also explore the effect of the ionic composition on the growth of gold nanoparticles. Ultimately, we demonstrate the sensing capabilities of these gold nanostructures via: (1) the sensitive chemical detection of rhodamine 6G and thiram (a pesticide); and (2) a specific biological assay to detect streptavidin on biotin-modified gold nanostructures.

Abstract

56. In-Flow Label-Free Imaging for Single Cell Analysis

Lisa Miccio [1,*], Pasquale Memmolo [1], Francesco Merola [1], Vittorio Bianco [1], Martina Mugnano [1], Massimiliano Villone [2], PierLuca Maffettone [2] and Pietro Ferraro [1]

[1] Institute of Applied Sciences and Intelligent Systems—ISASI- CNR, Via Campi Flegrei 34, 80078 Pozzuoli (NA), Italy

[2] Dipartimento di Ingegneria Chimica, dei Materiali e della Produzione Industriale, University of Naples "Federico II", Piazzale Tecchio 80, 80125 Napoli, Italy

* Correspondence: l.miccio@isasi.cnr.it

High-throughput and label-free analysis at single-cell scale is one of the most challenging research field among microscopy techniques. All-optical analysis in continuous flow would be desirable to supply a morphological identification of different class of cell. Such analysis, not related to specific florescent probes, would be, in principle, able to discern different biological species into an ensemble. The integration of label-free imaging technique into microfluidic devices open new perspective for lab-on-chip sensing for biomedical applications. Here, it will be showed a proof of concept for Tomographic Phase Microscopy (TPM) that combine digital holography and microfluidics for obtaining tomographic imaging of different cell types while flowing and rolling into a microchannel. Different strategies for rotation angle recovery will be presented both from the optical setup point of view and algorithm implementations thus achieving full 3D label-free characterization in continuous flow of Red Blood Cells (RBCs), White Blood Cells and tumor cells.

Abstract

57. Innovative Fiber-Optic Rotational Seismograph

Jaroszewicz R. Leszek [1,*], Anna Kurzych [1], Zbigniew Krajewski [1], Jerzy K. Kowalski [2], Henryk A. Kowalski [3] and Krzysztof P. Teysseyre [4]

[1] Faculty of Advanced Technologies and Chemistry, Military University of Technology
[2] Elproma Electronics Ltd.
[3] Faculty of Electronics and Information Technology, Warsaw University of Technology
[4] Institute of Geophysics, Polish Academy of Science
* Correspondence: jarosz@wat.edu.pl

Paper deals with innovative sensor suitable for rotational seismology which falls within rotational ground movements from earthquakes, explosions, and ambient vibrations. In spite of growing popularity of the rotational seismology there are still lack of appropriate rotational sensors for its field application also in form of seismograph which contains rotational sensor, data acquisition system with precise sensor localization and precision time monitoring.

From above reasons in this paper we describe construction, laboratory tests as well as the first field application of FOSREM® - the innovative Fiber-Optic Rotational Seismograph. The system based on fiber-optic gyroscope with measured Angle Random Walk on range 10^{-8} rad/Sqrt(s) and a few rad/s maximum detectable amplitude of rotation in frequency range from DC to 328.12 Hz designed it for rotational seismology area of interest. This work presents also exemplary relevant measurements of torsion and tilt effects resulting from mining seismic quakes induced by copper mining operations which were conducted using two seismographs in the geophysical observatory in Książ region, Poland.

Abstract

58. P3HT Processing Study for In-Liquid EGOFET Biosensors: Effects of the Solvent and the Surface

Matteo Parmeggiani [1,2,*], Alessio Verna [1], Alberto Ballesio [1], Matteo Cocuzza [1,3], Erik Piatti [1], Vittorio Fra [1], Candido Fabrizio Pirri [1,2] and Simone Luigi Marasso [1,3,*]

[1] Department of Applied Science and Technology (DISAT), Politecnico di Torino, Corso Duca degli Abruzzi 24, 10129 Torino, Italy
[2] Istituto Italiano di Tecnologia, Center for Sustainable Future Technologies, Via Livorno 60, 10144 Torino, Italy
[3] Istituto dei Materiali per l'Elettronica ed il Magnetismo, IMEM-CNR, Parco Area delle Scienze 37/A, 43124 Parma, Italy
* Correspondence: matteo.parmeggiani@polito.it (M.P.); simone.marasso@polito.it (S.L.M.)

In-liquid biosensing is the new frontier of cells real time monitoring and biomarkers detection. Electrolyte Gated Organic Field Effect Transistors (EGOFETs) are a promising technology for biosensing applications due to their high sensibility, low power consumption, biocompatibility and low-cost fabrication. In order to improve the stability and electrical properties of an EGOFET biosensor, in this study we investigate the effect of the solvent and of the substrate modification on thin films of organic semiconductor Poly(3-hexylthiophene) (P3HT). The studied surface is the relevant interface between the P3HT and the electrolyte acting as gate dielectric for in-liquid detection of an analyte. AFM and XPS characterizations were employed to study the effect of two solvents (toluene and 1,2-dichlorobenzene) and of the adhesion promoter (Ti prime) on the morphological structure and electronic properties of P3HT film. Combining the results from these surface characterizations with electrical measurements, we investigate the changes on the EGOFET performances and stability in DI water with an Ag/AgCl gate electrode.

Abstract

59. Peptide Assisted Imprinting for Turn-On Fluorescence Detection of Proteins

Edmondo Battista [1,*], Liana P Scognamiglio [2], Filippo Causa [1] and Paolo Antonio Netti [1,2]

[1] Interdisciplinary Research Centre on Biomaterials (CRIB), University of Naples "Federico II", Italy
[2] Istituto Italiano di Tecnologia, CABHC IIT@CRIB, Napoli, Italy
* Correspondence: edmondo.battista@unina.it

Current limitations in protein imprinting technology above all rely on poor cavity control for sensing purpose. [1,2]

The aim of this work is to obtain superior chemical control over the imprinted cavity by exploiting the interaction of selected peptides in order to realize new materials with integrated reporting systems. Herein we introduce a novel approach for the protein imprinting based on the introduction of a multifunctionalized peptide in the polymerization phase as reporting and active assistant recognition elements (AAREs) [3]. Such Hybrid Peptide-Polymer Imprinting (HyPPI) envisages a hydrogel matrix where a hybrid material is produced by the co-polymerization between monomers and specific peptides [3].

HyPPI showed low micromolar affinity for the imprinted protein as well as high selectivity. The derivatization of peptides with environment sensitive fluorochrome, such as Dansyl, allowed to reveal the presence of the imprinted protein and with appropriate calibration its concentration. This work represents an advance in the field of self reporting materials that can be integrated directly with optical microdevices and in this way a general tool that would mimick the biologic machinery is provided, through the adaptation of concepts of supramolecular complexes to bulk materials.

References

1. Ye, L.; Mosbach, K. *Chem. Mater.* **2008**, *20*, 859.
2. Sunayama, H.; Ooya, T.; Takeuchi, T. *Chem. Commun.* **2014**, *50*, 1347.
3. Battista, E.; et al. *J. Mate. Chem. B* **2018**, *6*, 1207–1215.

Abstract

60. 60 km Range Single-Ended Distributed Optical Fibre Vibration Sensor with In-Line Raman Amplification

Ali Masoudi

Optoelectronics Research Centre, University of Southampton; a.masoudi@soton.ac.uk

In this study, a single-ended distributed vibration sensor (DVS) with 60 km sensing range and 1m spatial resolution has been demonstrated. The DVS system used in this work was employing an optical fibre interferometer and differentiate and cross-multiplying demodulation algorithm to extract the phase information. In order to achieve this sensing range, an in-line Raman amplification has been employed to amplify both the probe pulse as it propagates down the sensing fibre as well as the backscattered light as it travels back towards the experimental setup. The layout of the setup used is shown in Figure 1. The seed laser source used to interrogate the pulse was an off-the shelf 1550 nm butterfly laser diode with 10 MHz linewidth and it was directly modulated to generate the probe pulse. The 1480 nm laser with an output power of 600 mW was used as Raman pump. The sensing system showed a strain sensitivity of 100 nε and a frequency range of up to 1500 Hz.

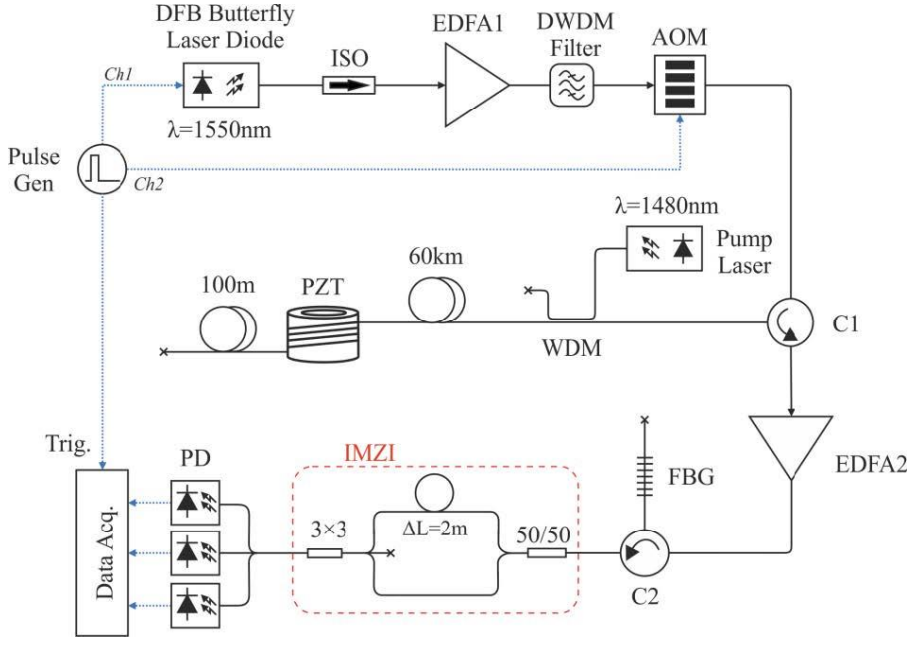


Figure 1. The schematic of the experimental setup used for single-ended distributed vibration sensor with 60km sensing range.

Abstract

61. Brillouin Optical Correlation-Domain Reflectometry: Current Status and Future Perspectives

Yosuke Mizuno *, Kohei Noda, Heeyoung Lee and Kentaro Nakamura

Tokyo Institute of Technology

* Correspondence: ymizuno@sonic.pi.titech.ac.jp

Aging degradation and seismic damage of civil infrastructures have recently posed a serious problem for society. One promising technology for monitoring the conditions of such structures is a distributed strain and temperature sensing based on Brillouin scattering in optical fibers, and a number of schemes have been reported thus far, including time-, frequency-, correlation-domain techniques. In this invited talk, we present the current status and future perspectives of Brillouin optical correlation-domain reflectometry (BOCDR). BOCDR, which operates based on the synthesis of optical coherence function, is an only technique that can simultaneously achieve operation by single-end light injection, high spatial resolution, random accessibility, and cost efficiency. One of its major drawbacks was the relatively low sampling rate, which has been recently mitigated by special schemes such as phase-detected BOCDR and slope-assisted BOCDR. We review these high-speed BOCDR schemes as well as the standard scheme and discuss the future challenges for the practical applications of BOCDR.

Abstract

62. Dynamic Phase Retrieval in a High-SNR DAS Based on UWFBGs without Phase Unwrapping Using a Scalable Homodyne Demodulation and Direct Detection

Yonas Muanenda [1,*], Stefano Faralli [1], Claudio J. Oton [1], Cheng Cheng [2], Minghong Yang [2] and Fabrizio Di Pasquale [1]

[1] Scuola Superiore Sant' Anna
[2] Wuhan University of Technology
* Correspondence: yonawgy@gmail.com

We report on the experimental demonstration of dynamic phase extraction in a high-SNR Distributed Acoustic Sensing (DAS) based an array of identical Ultra-Weak Fiber Bragg Gratings (UWFBGs) by using a φ-OTDR with delayed interferometry employing a simple narrowband laser and a single *pin* photodiode with a scalable demodulation technique. The interrogation scheme is highly suitable for distributed sensing involving continuous real-time monitoring, as it automatically avoids computationally intensive phase-unwrapping operations commonly used in conventional I-Q demodulation techniques without explicit clauses which handle error-prone division-by-zero operations. It is also scalable as it involves symmetric differentiation and integration operations which, thanks to a rich set of available techniques for performing fractional order calculus, can be implemented with multi-channel FPGA-based systems or analogue processing circuits employing operational amplifiers, which are also candidates for small-scale integration compatible with silicon photonics. We experimentally demonstrate the dynamic measurement of a generic 2.5 kHz vibration applied to a PZT actuator at the end of an array of 200 UWFBGs, each with a reflectivity of ~−43 dB and spaced at 5 m, with an SNR of ~34.52 dB.

Abstract

63. High-Spatial Resolution Brillouin Sensing: Evaluation Tests for Temperature Monitoring in Aerospace Scenarios

Romeo Bernini [1], Agnese Coscetta [2], Enis Cerri [3,*], Ester Catalano [2], Carlos Miguel-Giraldo [4], Joaquin Rams [5], Luigi Zeni [2] and Aldo Minardo [2]

[1] Istituto per il Rilevamento Elettromagnetico dell'Ambiente—CNR
[2] Department of Engineering, Università della Campania "Luigi Vanvitelli"
[3] Department of Engineering, University of Campania Luigi Vanvitelli
[4] Airbus Operations, S.L, Paseo John Lennon S/N, Getafe, 28906 Madrid, Spain
[5] Universidad Rey Juan Carlos, Madrid, Spain
* Correspondence: enis.cerri@unicampania.it

The BRIDAS project, funded by European Commission under Clean Sky 2 Programme, is aimed at developing and testing a portable interrogation unit for distributed strain and temperature sensing in optical fibers for aerospace scenarios. The system is used to support the online inspection process and structural health evaluation of composite parts along their different life phases. At the manufacturing stage of the parts, the system should contribute to the quality control of the parts through the optical fibers introduced in this initial phase. When the parts are loaded in either structural test platforms or in-service life, the same optical fibers provide structural health monitoring (SHM) and operational loads monitoring (OLM). In this paper, we report a number of temperature measurements performed at Airbus facilities in Getafe (Spain), using a high-spatial resolution (5 mm) Brillouin Optical Frequency-Domain Analysis (BOFDA) interrogation unit. BOFDA provides distributed sensing capabilities at high spatial resolution, making use of a continuous wave (CW) pump wave with superimposed a small-signal modulation. The results of measurements were compared to those provided by fiber Bragg gratings (FBGs) and thermocouples, demonstrating the capabilities of BOFDA technology for temperature measurement of composite parts along their different life phases, from manufacturing plants, to structural test platforms and airborne conditions.

Abstract

64. Wavelength-Scanning Distributed Acoustic Sensing for Structural Monitoring and Seismic Applications

Sascha Liehr *, Sven Münzenberger and Katerina Krebber

Bundesanstalt für Materialforschung und -prüfung (BAM)

* Correspondence: sascha.liehr@bam.de

Distributed acoustic sensing (DAS) in optical fibers experienced a dynamic development in recent years. A wide range of approaches has been proposed and the performance continues to improve. The field of DAS applications is constantly growing as more and more conservative branches are beginning to adopt DAS technology.

We demonstrate the use of distributed and dynamic strain measurement for two application areas with significant commercial potential: (*i*) The structural health monitoring (SHM) sector, and (*ii*) ground deformation measurement along telecom cables in urban environment. We show vibration measurement results of a fiber-equipped model bridge as an example for the distributed high-resolution data quality that can now be used for advanced structural analysis. In a second use case scenario, we measure the distributed ground movement along a dark fiber in an underground telecom cable. This approach allows for easy access to urban data with prospects for traffic monitoring, road condition monitoring or seismic applications.

All measurements are conducted using the wavelength-scanning coherent optical time domain reflectometry (WS-COTDR) technique. We briefly introduce the method and the experimental setup. We use artificial neural networks (ANNs) that are trained to compute strain from raw measurement data. The use of ANNs not only improves the strain resolution and sensor linearity, but also reduces the computation time by more than two orders of magnitude. ANNs enable to conduct real-time strain sensing using WS-COTDR.

Abstract

65. Object Tracking Based on (*m*,*k*)-Firm Model in Multimedia Wireless Sensor Networks

Beom-Su Kim [1], Ki-Il Kim [1,*], Tae-Eung Sung [2], Babar Shah [3], Francis Chow [4] and Kyong Hoon Kim [5]

[1] Chungnam National University
[2] Department of Computer and Telecommunications Engineering, College of Science and Technology, Yonsei University
[3] Zayed University
[4] University College, Zayed University
[5] Gyeongsang National University
* Correspondence: kikim@gnu.ac.kr

Object tracking is one of the most promising applications in wireless sensor networks (WSN). However, current scalar based WSN cannot provide diverse object information for type and shape of object. To defeat this problem, multimedia WSN is employed to support various information for the object. When using multimedia, service quality problems naturally arise, which makes it necessary for network technology as to support service quality stably. In this paper, we present real-time network technology for applying (*m*,*k*)-firm stream to object tracking in multimedia WSN. The proposed method satisfies the (*m*,*k*)-firm requirement of the data transmitted from each sensor node to the sink, and at the same time, aggregates the multimedia data to compensate the technology at intermediate node. In addition, according to current status, adaptive QoS routing protocol chooses the path to satisfy the new (*m*,k)-firm for users. Finally, simulation result is given to prove the suitability of the proposed scheme by presenting stream dynamic failure ratio value for the (*m*,*k*)-firm stream.

Abstract

66. Magnetic Properties and Applications of Glass-Coated Ferromagnetic Microwires

Valentina Zhukova [1,2], Paula Corte-Leon [1], Mihail Ipatov [1,2], Juan Maria Blanco [2] and Arcady Zhukov [1,2,3,*]

[1] Dpto. Fisica de Materiales, Fac. Quimicas, UPV/EHU, 20018 San Sebastian, Spain
[2] Dpto. de Fisica Aplicada, EUPDS, UPV/EHU, 20018, San Sebastian, Spain
[3] IKERBASQUE, Basque Foundation for Science, 48011 Bilbao, Spain
* Correspondence: arkadi.joukov@ehu.es

Development of magnetic sensors is focused on the miniaturization of their size, improvement of their features and on finding of new materials. Among new magnetic materials a family of thin wire with reduced dimensions recently gained considerable attention [1]. Glass-coated magnetic microwires prepared using the Taylor-Ulitovsky technique with thin metallic nucleus (typically with diameters 0.5 to 50 μm) covered by flexible, insulating and biocompatible glass are therefore quite interesting for sensor applications [2]. This technique allows preparation of the thinnest rapidly quenched wires with amorphous or crystalline structure of metallic nucleus. Good magnetic properties can be observed either in crystalline or in amorphous magnetic wires, but amorphous magnetic wires present several advantages, such as superior mechanical properties, the absence of the microstructure defects (grain boundaries, crystalline texture, dislocations, point defects, …) [2] and hence precise post-processing is not required.. Particularly, amorphous microwires can present giant magneto-impedance (GMI) or magnetic bstability. In the case of glass-coated microwires the magnetoelastic anisotropy contribution becomes relevant since the preparation process involves not only the rapid quenching itself, but also simultaneous solidification of the metallic nucleus surrounded by non-magnetic glass-coating with rather different thermal expansion coefficients [2]. We present the results on tailoring of soft magnetic properties and GMI effect in glass-coated microwires paying special attention to achievement of high GMI effect and on optimization of domain wall dynamics.

References

1. Jiles, D.C. *Acta Mater.* **2003**, *51*, 5907.
2. Zhukova, V.; et al. *Acta Mater.* **2018**, *155*, 279.

Abstract

67. Optical System for Variable Depolarizer Characterization

Aleksandra Kalbarczyk, Jaroszewicz R. Leszek *, Noureddine Bennis, Monika Chruściel and Pawel Marc

Faculty of Advanced Technologies and Chemistry, Military University of Technology

* Correspondence: jarosz@wat.edu.pl

Photonics use interferometer in many technical applications. Regards they high accuracy and due to the non-destructive property are often used for instance in medical diagnostics as optical coherence topography instruments, blood flow, middle ear or infectious diseases. The interferometric measurement methods based on comparing images obtained from a CCD camera were proposed, also All above applications use polarized light with well-defined state of polarization for their proper works according to Fresnel -Arago conditions.

However many optical applications often require totally depolarized light. In depolarizing instrument, such as a broadband imaging spectrometer, the depolarizers are placed on system for stabilization the optical signal. They are also used in order to reduce measurements offsets due to strong polarization dependence, which produce drastic deterioration of the signal to noise ratio. Dynamic depolarizer with controllable degree of polarization is also required for study the effect of noise on quantum information. Article described a new instrument for characterization the variable depolarizer with features which make it different from a polarimetric system. The analysing system based on the simple structure design and has good stability for real time measurement. A practical application of described interferometer system for variable depolarizer characterization are also presented.

Abstract

68. A Remote WSN for Rockfall Monitoring in Hostileenvironment

Gianluca Barile, Giuseppe Ferri, Alfiero Leoni, Mirco Muttillo, Leonardo Pantoli * and Vincenzo Stornelli

University of L'Aquila
* Correspondence: leonardo.pantoli@univaq.it

We here present an autonomous wireless sensor network (A-WSN) for the detection andmonitoring of rockfall barrier in hostile territory. The proposed sensor has been applied to themonitoring and detection of rockfall events on protection barriers so to control its dynamicbehavior and, in case of impact event, to adopt the necessary actions, if any criticism occurs. Thesystem constitutes a completely autonomous sensor network thanks to the presence of an energyharvesting photovoltaic architecture, composed by a multifunction data-logger and wireless sensornodes. The measured data at nodes are related to acceleration, inclination, position andtemperature. The WSN communication is designed in a free UHF frequency band (433 MHz), while the datatransmission on a dedicated web server is performed by using a GSM mobile link. The dataacquisition timing can be set in two different operating modes: (1) an asynchronousinterrogation mode; (2) a timed samples mode with all the sensors sampled at a pre-fixed timeinterval. A remote server stores the measured data employing an automatic alarm algorithm.Measured results are here presented and discussed.

Abstract

69. Analytical and Numerical Simulations of a Fast Wide-Range AWG-Based Interrogation Technique for FBG Sensor

Vincenzo Romano Marrazzo *, Giovanni Breglio and Andrea Irace

Department of Electrical Engineering and Information Technologies, Federico II, Naples, Italy
* Correspondence: vincenzoromano.marrazzo@unina.it

A new interrogation technique for distributed fiber Bragg grating (FBG) sensors that employs an arrayed waveguide grating (AWG) is proposed and its operating features are investigated theoretically and numerically. The developed interrogator consists of a fully passive, small, rugged optical devices and can detect wavelengths of a great number of FBG sensors with high precision and high speed. A part of the light generated from a source is reflected at a certain wavelength from the fiber Bragg grating sensor in function of the strain or temperature that is applied on; the reflected wave is then analyzed from the AWG that works as a wavelength filter. The output optical signal is then converted in electrical signal through an array of photodetectors and elaborated from a FPGI customized algorithm of conversion.The analytical and numerical simulation show that the shift of the Bragg wavelength of the FBG sensors can be precisely interrogated by the relative power reading of two-adjacent-channels of the AWG-based filter. Errors caused by the light source fluctuation and micro-band losses can be reduced with this approach. This technique potentially offers a low-cost, compact, and high-performance solution for the interrogation of FBG distributed sensors.

Abstract

70. Assembly of Nanostructures Using an AC Electric Field for Detection and Identification of Analytes Using Surface-Enhanced Raman Scattering (SERS)

Joshua Raveendran, Hannah Dies, Carlos Escobedo and Aristides Docoslis *

Queen's University

* Correspondence: docoslis@queensu.ca

This work presents a novel method that employs an alternating current (AC) electric field for rapidly assembling extended and ultra-sensitive SERS-active silver nanostructures on a planar microelectrode platform. The structures exhibit impressive SERS activity with an enhancement factor of 6.3×10^6. The metal nanostructures grow outward from the edges of the microelectrodes and along the surface of the insulating microelectrode support. The applied voltage determines the mode of assembly and morphology of the resulting nanostructures. Analytes such as melamine and the pesticide thiram were detected at clinically relevant levels. Furthermore, since the structures constitute physical extensions of the planar microelectrodes they can be electrically energized and, thus, also be used for active electrokinetic trapping (concentration amplification) of analytes from a liquid sample. This concept is illustrated here with the trapping and detection of FITC-tagged avidin. Our SERS-active silver nanostructures can be readily removed after each SERS testing and replaced within a couple of minutes on the same microelectrode platform.

Abstract

71. Automatic Generation of Datasets for Learning-Based UAV Pipe Detection by Computer Vision

Edmundo Guerra [1], Yolanda Bolea [1], Rodrigo Munguia [2] and Antoni Grau [1,*]

[1] Technical Univ of Catalonia
[2] Universidad de Guadalajara, Mexico
* Correspondence: antoni.grau@upc.edu

Scene segmentation and interpretation is a problem to solve in order to deploy autonomous robots into industrial environments. In this particular case, an autonomous robot based in a robotized UAV (Unmanned Aerial Vehicles) platform must detect and locate industrial pipes. Prior works rely in multimodal perception or high specifications sensors to guarantee the robustness of the sensing process. This work proposes exploiting one of these solutions relying in a low rate (10 Hz) LiDAR sensor, to create an automated framework to label image datasets of images captured in real flight in industrial environments. Data from the LiDAR and the UAV state is used by the framework proposed to label images with pipe detections and pose recoveries. This produces an initial dataset (of real in-flight captured images) which is processed with data augmentation to obtain a functional dataset, in turn used to train well known network architectures and test their accuracy and performance in an embedded single board computer.

Abstract

72. Design of Double Three-Contact Vertical Hall Device Based on Conformal Mapping Technology

Rongshan Wei * and Yuxuan Du

College of Physics and Information Engineering, Fuzhou University, Fuzhou 350116, China

* Correspondence: wrs08@fzu.edu.cn

A vertical Hall device is an important component of three-dimensional Hall sensors. Existing research is mainly based on five-contact structures. The structure leads to an asymmetrical current path and consequently a large offset voltage when using a rotating-current method. We propose a new structure using a double three-contact vertical Hall-device and a new conformal mapping technique for performance evaluation. We simulated the device structure and fabrication process using TCAD software and then used the computational and simulation data to further optimizethe location and size of the contacts. Our results show that the double three-contact vertical Hall-device structure had a lower offset voltage than five- and four-contact structures. In the four phases of the rotating-current method, the maximum offset voltage was 1.2 mV. The prediction method proposed in this study can provide a theoretical basis for the improvement of device performance and can predict the sensitivityof the double three-contact structure. The research outcomes can provide a new structure and performance prediction method for the design of Hall devices.

Abstract

73. Evanescent Field Monitoring for Film Thickness Evaluation in Metallic Layer Surface Plasmon Resonance Biosensor Setup

Ramona Galatus [1], Nicoleta Tosa [2], Paul Farago [3], Piotr Miluski [4], Cecilia Cristea [5] and Aranka Ilea [5]

[1] Technical University of Cluj-Napoca
[2] INCDTIM-National Institute for Research and Development of Isotopic and Molecular Technologies, Cluj-Napoca, Romania
[3] Technical University of Cluj-Napoca, Romania
[4] Bialystok University of Technology, Poland
[5] University of Medicine and Pharmacy "Iuliu Hatieganu", Cluj-Napoca, Romania
* Correspondence: ramona.galatus@bel.utcluj.ro

A surface plasmon resonance (SPR) optical biosensor based setup, with gold layer configuration that integrates the evanescent field monitoring option in IR region, for the evaluation of the metallic film thickness is presented. A rhodamine B doped, polymethyl methacrylate optical fibre having a green laser pointer (532 nm, 808 nm, 10 mW) as excitation pump and the output emission spectra of the fiber, between 620–750 nm, was used as light source for the SPR plastic optical fiber sensor. The metal's plasmonic resonance wavelength was matched with the emission of the luminescent spectrum of the Rhodamine B optical fiber. The IR radiation at 808nm has no contribution for the luminescence of the doped-fiber and is used for the thickness evaluation of the SPR metallic layer, at different measurement-cycle, to monitor the repeatability of the measurements using the same SPR sensing platform, at a specific analyte. The SPR sensor response was evaluated with different glycerin based aqueous solutions (with different refractive index).

Abstract

74. FBG-Based Monitoring System for Smart Tires Application with Wireless Instrumentation under Real-Time Rolling Condition

Vincenzo Romano Marrazzo [1,*], Salvatore Strano [2], Michele Riccio [1], Francesco Fienga [3], Mario Terzo [2], Andrea Irace [1] and Giovanni Breglio [1]

[1] Department of Electrical Engineering and Information Technologies, Federico II, Naples, Italy
[2] Department of Industrial Engineering, Federico II, Naples, Italy
[3] National Institute for Nuclear Physics (INFN), Napoli Section, Naples, Italy
* Correspondence: vincenzoromano.marrazzo@unina.it

Nowadays, the Tire Pressure Monitoring System (TPMS) is the only sensing system employed in tires which gives to the driver information about tire working condition. The goal of this study is to present a strain and temperature sensing system architecture for smart tires through the employment of Fiber Bragg Grating (FBG) sensors that are embedded into the internal surface of the tire. A non-invasive wireless dynamic measurement system is proposed: many FBGs are interrogated directly onto the internal surface of the tire allowing strain and temperature measurement in rolling condition without modifying rim or using complex tools. Data are processed in real time obtaining, from wavelength measurement, information on temperature, vertical load, deformation area, longitudinal and circumferential forces. This configuration is not able to get a strain mapping of the tire as others but is possible to measure tire parameters in dynamic behavior such as maximum tensile, compressive limits and information about contact patch that are actually monitored with invasive and expensive sensing systems.

Abstract

75. Feasibility Study on Fabric-Sheet Unified Sensing Electrode for Non-Contact In-Bed Measurements of ECG, Body Proximity and Respiratory Movement

Yuichiro Sakajiri

Tokyo Denki University, Senju Asahi-cho 5, Adachi-ku, Tokyo 120-8551, Japan

* Correspondence: 18kmj15@ms.dendai.ac.jp

In a recent article, we have reported that a fabric-sheet unified sensing electrode (FUSE) can detect electrocardiogram (ECG), body proximity at the chest and abdomen (BPx_{chest}, BPx_{abd}), and respiratory movement at the abdomen (RM_{abd}) via worn clothes and bedsheet simultaneously from recumbent human subjects. In the article, however, verification of its measurement principles and fundamental evaluation were only done. In the current research, we conducted feasibility study involving many subjects to assess the influence of individual differences on this FUSE system. We totally proceeded 31 measurements for 9 males and 12 females (body mass index: 16.0 to 29.0 kg/m^2). We asked the subjects to keep rest for 5 min in a supine position on a bed, then to sit up at the end of the measurement. Analysis of the measurements revealed that the accuracies of ECG R wave and RM_{abd} were 97.8 ± 2% and 91.9 ± 13%, respectively. Voltage differences in BPx_{chest} and BPx_{abd} caused by sit-up motion were ranged from 0.2 to 4.0 V and from 0.2 to 6.0 V, respectively. The variety of the voltage differences was attributed to the variety of the site of the dorsal body surface coupled onto the FUSE. These results suggest that individual difference of physical constitution has little impact on both accuracies of ECG R wave and RM_{abd} under the current FUSE configuration, but has some influence on the voltage difference of BPx caused by postural change. Therefore, we deemed to revise the FUSE configuration to avoid individual threshold setting for sit-up detection.

Abstract

76. Integrated Bidirectional Inductive-Array Design for Power Transfer in Implantable BioMEMS

Natiely Hernández Sebastián [1,*], Wilfrido Calleja Arriaga [1], Francisco Javier Renero Carrillo [1] and Daniela Díaz Alonso [2]

[1] National institute of Astrophysics, Optics and Electronics
[2] Center for Engineering and Industrial Development
* Correspondence: natiely@inaoep.mx

Inductive Power Transfer (IPT) is a key technique for the development of new schemes aimed for energy supplying in a wide variety of Implantable Medical Devices (IMD), this kind of developments are more strategic for bidirectional applications. IPT modules are pursued keeping higher Power Transmission Efficiency (PTE) and robustness under limited space conditions, hence new tridimensional (3D-like) inductors offering high inductance and quality factor (L, Q) are required based on advanced fabrication techniques. Currently IMD design are reported offering limited specifications because the influence of restricted size and the use of conventional design techniques. An alternative strategy for the design of a bidirectional IPT module capable of continuous monitoring of cardiac pressure is presented. The proposed work is based on electromagnetic coupling from a robust external reading coil device and an implanted two-level (3D approach) inductor array. In this bidirectional transmission design, each coupling module follows a 13.56 MHz operating frequency, where passive RCL networks are cross field tuned keeping restricted physical design for the implanted module and considering effective coupling across biological tissue. The design procedure is based on ANSYS HFSS software. The main specifications are as follows: PTE amounts 90% across compound 3.5 cm-thick biological tissue; the implanted coil array is very thin with 18 mm diameter, which is about 50% of conventional reported inductor size. Because the obtained PTE is 40% higher mainly based on the combined high L and Q, this novel bidirectional transmission approach can be highlighted and is supported by low cost fabrication technology.

Abstract

77. Investigating Changes to the Biosensing Mechanism by Tuning the Concentrations of Graphene Quantum Dots towards the Optical Detection of Ochratoxin A

Wei Li Ang * and Alessandra Bonanni

Nanyang Technological University, Singapore
* Correspondence: weili001@e.ntu.edu.sg

The consistent need for a simple and affordable biosensor is of utmost importance, owing to the increase demands for a straightforward analysis of food quality and food safety. As such, Graphene Quantum Dots (GQDs) was utilized, not only as the platform for the biorecognition element but also function as nanoquenchers for the optical detection of a major food contaminant, Ochratoxin A (OTA) in food. Therefore, GQDs, was employed as the biosensing platform in conjunction with a fluorescent-labelled DNA aptamer (FAM OTA Aptamer) as the biorecognition element towards the optical detection of OTA. The detection principle lies in the formation of non-covalent interactions between the biorecognition element and the platform, resulting in a decrease in the fluorescence intensity of the initial signal from the fluorescent label. Further changes in the signal, resulting from the formation of the FAM OTA Aptamer/OTA conjugate during the detection step, could be correlated to the quantification of the target analyte in solution. It was uncovered, in this work that a switch in the biosensing mechanism could be achieved by controlling the concentrations of the GQDs utilized with 0.060 mg/mL resulting in a further decrease of the signal and 0.150 mg/mL resulting in a restoration of the signal upon subsequent incubation with OTA. Interestingly, the switch in the behavior was determined to be at 0.115 mg/mL.

Abstract

78. Preliminary Study for Detection of Hydrogen Peroxide Using a Hydroxyethyl Cellulose Membrane

Helena Vasconcelos [1,2], José Manuel Almeida [2,3], Cristina Saraiva [1], Pedro Jorge [2,4] and Luis Coelho [5,*]

[1] School of Agrarian and Veterinary Sciences, CECAV-Centro de Ciência Animal e Veterinária, Univ. of Trás-os-Montes e Alto Douro, 5001-801 Vila Real, Portugal
[2] INESC TEC, Technology and Science and Faculty of Sciences, Univ. of Porto, Rua do Campo Alegre, 4169-007 Porto, Portugal
[3] Department of Physics, School of Science and Technology, Univ. of Trás-os-Montes e Alto Douro, 5001-801 Vila Real, Portugal
[4] Department of Physics and Astronomy of Faculty of Sciences, Univ. of Porto, 4169-007 Porto, Portugal
[5] INESCTEC—Institute for Systems and Computer Engineering, Technology and Science and Faculty of Sciences, Univ. of Porto, Rua do Campo Alegre, 4169-007 Porto, Portugal
* Correspondence: lcoelho@inesctec.pt

The formation of biogenic amines (Bas) is used as an indication of food spoilage making the determination of their concentration in foods an important method of food control. BAs are nitrogenous organic bases of low molecular weight and can be found in a variety of food products including meat, seafood, dairy, fruits, vegetables, chocolates nuts and fermented products. Usually, these nitrogen compounds are formed mainly by microbial decarboxylation of amino acids and by amination and transamination of aldehydes and ketones. These can be precursors of nitrosamines, which have been connected to carcinogenic and mutagenic activity. The detection and quantification of BAs can be determined by a chemiluminescent method. However, BA do not have chemiluminescence properties, hydrogen peroxide (H_2O_2), which is a side product of its degradation by the enzyme such as, diamine oxidase, is used to obtain luminescence when reaction with 5-amino-2,3-dihydrophthalazine-1,4-dione ($C_8H_7N_3O_2$) occurs.

In this work, we present a chemiluminescence based technique to measure small quantities of H_2O_2 added to a membrane consisting of hydroxyethyl cellulose. The results of this study shown that with this method it is possible to detect very low concentrations of H_2O_2 down to 0.01% *w*/*w* with resolutions better than 0.0025% *w*/*w* in the range up to 0.04% *w*/*w*.

Abstract

79. A Comparison of Classic and Machine-Learning Approaches to Determine Soil Salinity and Soil Water Content Using Time Domain Reflectometry

Basem Aljoumani [1,*], Josep Sanchez-Espigares [2], Steffen Trinks [1] and Andre Peters[3]

[1] Department of Ecology, Ecohydrology and Landscape Evaluation, Technische Universität Berlin Ernst-Reuter Platz 1, 10587 Berlin, Germany
[2] Department of Statistical and Operational Research, Universitat Politècnica de Catalunya (UPC), Spain
[3] Division of Soil Science and Soil Physics, Institute of Geoecology, Technische Universität Braunschweig, Germany
* Correspondence: basem.aljoumani@tu-berlin.de

Determining the accumulation of salts in soil and the soil water regime are mandatory to avoid its negative impact on human and natural assets such as plants, aquatic ecosystems, water supplies, agriculture and infrastructure. Electrical conductivity of the liquid phase (σ_p) is a good indicator of the salt concentration in the soil water. Electromagnetic soil sensors are capable to measure soil relative dielectric permittivity (ε_b), water content (θ), soil bulk electrical conductivity (σ_b) and soil temperature(t). σ_b is ascertained by the three conductance pathways: (i) solid phase pathway, (ii) liquid phase pathway, and (iii) solid-liquid interphase pathway. Thus, a method is required to transform σ_b to σ_p. in this study, we compare two different methods to transform σ_b to σ_p. We will measure time series of soil dielectric permittivity (ε_b), soil temperature (t) and soil bulk electrical conductivity (σ_b) using frequency domain reflectometry sensors in 5 sandy soil columns. The soil columns will be moistened with different molarities of KCl-solution. HYDRUS-1D, a physically-based numerical model for water and solute transport in porous media will be combined with a machine learning model to simulate time series of soil water and soil pore water electrical conductivity.

Abstract

80. A Fluorescent Nanodiamond Biosensor: Towards Free Radical Sensing in Chronologically Ageing Yeast Cells

Kiran Van der Laan *, Julie Naulleau, Viraj G Damle, Alina Sigaeva, Nicolas Jamot, Felipe P Perona-Martinez, Mayeul Chipaux and Romana Schirhagl

University Medical Center Groningen, University of Groningen, Department of Biomedical Engineering
* Correspondence: kiranvanderlaan@gmail.com

A Fluorescent Nanodiamond Biosensor: Towards Free Radical Sensing in Chronologically Ageing Yeast Cells

Kiran J. van der Laan, Julie Naulleau, Viraj G. Damle, Alina Sigaeva, Nicolas Jamot, Felipe P. Perona-Martinez, Mayeul Chipaux, and Romana Schirhagl

Understanding the mechanisms of ageing is one of the important challenges in the current ageing population. The formation and accumulation of free radicals is believed to be one of the causes for ageing, but the exact role of free radicals remains largely unknown and has been strongly debated in the past decades. We propose to use nanodiamonds as biosensors to detect these radicals, to unravel the causes of ageing at a molecular level. In diamond magnetometry, fluorescent nanodiamonds function as magnetic sensors that change their optical properties depending on their magnetic surrounding. In this work, we have obtained successful and harmless internalization of FNDs into ageing yeast cells. Next we have studied the response of the cells after uptake, and their chronological lifespan was shown to be unchanged after diamond uptake. Finally, we have analyzed the destiny of the diamonds inside these cells. Altogether, this work demonstrates the great potentials of using FNDs as magnetic sensors to study the exact role of free radicals in ageing yeast cells. Herewith, we aim to study both the precise location and identity of free radical formation, contributing to our understanding of the ageing process [1].

Reference

1. *Anal. Chem.* **2018**, *90*, 13506–13513.

Abstract

81. A Low Cost Wide Range Plane-in-Out Displacement Measurement Sensor Based on Twisted Macro-Bend Coupling Method

Abdul Ghaffar [1,2,*], YuLong Hou [1,2], LiYong Wei [1,2], HuiXin Zhang [1,2] and WenYi Liu [1,2]

[1] Science and Technology on Electronic Test, Measurement Laboratory, North University of China, Taiyuan 030051, China
[2] Key Laboratory of Instrumentation Science, Dynamic Measurement, Ministry of Education, North University of China, Taiyuan, China
* Correspondence: 92ghaffar@gmail.com

The twisted macro-bend coupling method TMBCM is a simple sensing approach which owns no signal processing or other complex methods. This article highlight the approach towards plane-in-out displacement sensor using multimode plastic optical fiber. In TMBCM method, when fiber becomes drifting the bend radius of fiber will change and macro-bend loss will rise. The twisted coupling method employed to couple power in passive fiber and calibrated throughout according to displacement drifting. In the experiment, we developed one twisted circular-bend on a single light transmitting fiber and achieved displacement up to 60 mm on both sides of Plane-in-out. However, to increase the range system we cascading the TMBCM and extend the range of plane-in-out displacement sensor up to 100 mm. As compared to the laser-based system and other techniques, the designed sensor is simple, cheap and easy to assemble. Whereas, cascading the TMBCM can be also used for simultaneous measurement of two different physical parameters.

Abstract

82. A PoCT Microfluidic Device Based on Monolithic HFF-QCM Sensor Array

María Calero [1], Román Fernández [2,*], Pablo García [2], José Vicente García [2], Yolanda Jiménez [1] and Antonio Arnau [1]

[1] Centro de Investigación e Innovación en Bioingeniería, Universitat Politècnica de València
[2] Advanced Wave Sensors S. L.
* Correspondence: rfernandez@awsensors.com

Point-of-Care Testing (PoCT) is a very promising tool to provide early diagnostic and patient monitoring information in a large number of medical conditions, e.g., cancer, cardiovascular, and infectious diseases. Acoustic wave sensing is considered an adequate candidate technology to implement such PoCT systems because of its sensitivity, low cost, and integration capability. In this work, the development and validation of a microfluidic device specifically designed to provide a reliable method to deliver liquid sample to a monolithic array of 24 HFF-QCM (High-Fundamental Frequency Quartz Crystal Microbalance) in PoCT applications is presented. The device also works as an electrical, mechanical and thermal interface between the sensors and the characterization instrument. Main requirements of the device include a low-volume flow chamber in the microliter range, and a system approach that provides the appropriate pressure control for assuring liquid confinement while maintaining the integrity of the sensor with a good base line stability.

Abstract

83. A Simple Spectral Interrogation System for Optical Fiber Sensors

Paulo Santos [1], José Manuel Almeida [1,2], Pedro Jorge [1,3] and Luis Coelho [1,*]

[1] INESCTEC—Institute for Systems and Computer Engineering, Technology and Science and Faculty of Sciences, Univ. of Porto, Rua do Campo Alegre, 4169-007 Porto, Portugal
[2] Dep. of Physics, School of Science and Technology, Univ. of Trás-os-Montes e Alto Douro, 5001-801 Vila Real, Portugal
[3] Dep. of Physics and Astronomy of Faculty of Sciences, Univ. of Porto, 4169-007 Porto, Portugal
* Correspondence: lcoelho@inesctec.pt

Optical fiber sensors (OFS) tolerate high temperatures, resist to many organic and inorganic chemicals and possess immunity to electromagnetic interference. The inherent flexible geometries make them attractive solutions for detection systems in remote areas.

The wavelength characterization of broad-band OFS based on long-period fiber gratings (LPFG) or surface plasmon resonance (SPR) is of paramount importance. Several systems are currently used, most of them require broadband light sources and optical spectrum analyzers (OSA), leading to bulk and costly systems, which is non-appropriate for field applications.

A spectral interrogation system consisting on the wavelength modulation of three fiber coupled distributed feedback (DFB) lasers is under implementation and testing. The intensity of each DFB laser is modulated by the OFS and the signal measured by a single photodetector. The transmission spectrum of the OFS is then reconstructed through a curve fitting processing.

Testing of the system was accomplished by measuring the spectral features wavelength and optical power shift induced by changing the refractive index of the medium surrounding a LPFG sensor using and OSA and the developed system. The maximum wavelength and optical power deviations were 2.8 nm and 2.9 dB, respectively, in the wavelength range from 1530 to 1570 nm. The refractive index resolution of the developed system is expected to be better than 3.14×10^{-3}.

Abstract

84. Adaptive and Sensitive Fibre-Optic Fluorimetric Transducer for Air- and Water-Borne Analytes

Alhulw H Alshammari [1,*], Abraham T Kirwa [1], Alan Dunbar [2] and Martin Grell [1]

[1] Physics and Astronomy, University of Sheffield, Hicks Building, Hounsfield Rd, Sheffield S3 7RH, UK
[2] Chemical and Biological Engineering, The University of Sheffield, Mappin St., Sheffield S1 3JD, UK
* Correspondence: ahfalshammari1@sheffield.ac.uk

A sensitive fibre optic fluorescence intensity meter has been designed and built as a transducer to detect quenching of conjugated polymer fluorescence with minimum adjustment between air- and waterborne analytes. Only generic, commercially available parts including optical fibres, solvents, airbrush, standard optical and electronic parts, and a digital lock-in amplifier have been used, avoiding the need for a fluorescence spectrometer. To test the instrument, optical fibres were sensitised with the generic fluorescent poly(phenylene-vinylene) derivative MDMO-PPV and exposed to a variety of vapour pressures, and concentrations in water, of the nitroaromatic explosive 2,4 dinitrotoluene (DNT). We establish dimensionless Stern-Volmer constants (K_{SV}) and limit-of-detection (LoD) for air- and water-borne DNT as $K_{SV}(air) = 1.4 \times 10^7$ *vs.* $K_{SV}(water) = 5.8 \times 10^6$ and LoD(air) = 10.9 ppb and LoD(water) = 56 ppb. These LoDs compare favourably to prior reports. We consider our study of the MDMO-PPV/DNT system as a successful test of our transducer design and recommend its wider use.

Abstract

85. An Ultra-High-Frequency Surface-Acoustic-Wave Lab-on-Chip for the Detection of Brain-Pathology Biomarkers

Matteo Agostini *, Gina Greco, Francesco Amato and Marco Cecchini

NEST, Istituto Nanoscienze-CNR and Scuola Normale Superiore, Piazza San Silvestro 12, 56127 Pisa, Italy

* Correspondence: matteo.agostini@sns.it

Glial-fibrillary-acidic-protein (GFAP) has been recently discovered as a biomarker for severe brain-related pathologies [1]. The interest in GFAP is related to several aspects. First, the importance of the pathologies that can be addressed: severe traumatic injuries, intracerebral hemorrhage and glioblastoma multiforme cancer. Second, the possibility of detecting this biomarker in circulating blood. Lab-on-a-chips (LoCs) have recently drawn significant attention as ideal technologies for the detection of biomarkers. This is because of the possibility of miniaturizing and speeding up the assays, and contemporary decreasing costs, increasing portability, facilitating integration with other technologies.In this context, Rayleigh surface acoustic waves (SAWs) are an effective means for realizing LoCs. SAWs interact with fluids and activate a number of microfluidic phenomena, such as mixing, droplet actuation, microparticle manipulation, nebulization and micropumping, to name but a few [2]. In a previous work, we also developed ultra-high-frequency (UHF) SAW acoustic resonators fabricated and proposed for biosensing applications (Figure 1). Their limit of detection was far better than that of standard commercial microgravimetric sensors [3].Here, I show a LoC based on UHF-SAWs for the detection of GFAP. The combination of SAW-biosensing and SAW-microfluidics on the same chip allowed the effective detection of GFAP [4]. The UHF-SAW resonators multiplexing and the SAW-induced recirculation of the fluid inside the microchambers were fundamental for the detection of GFAP with antibodies immobilized on the biosensor surface. This SAW-LoC can be further developed and engineered with the aim of realizing a point-of-care biosensing platform for the detection of multiple brain-pathology biomarkers.

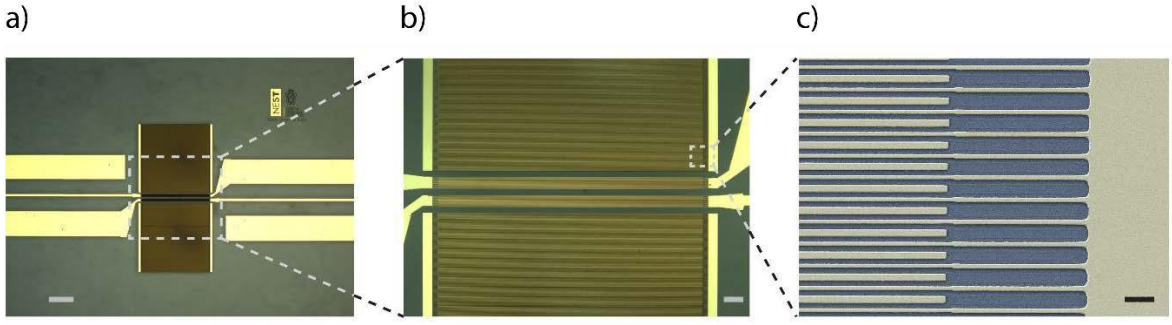


Figure 1. UHF-SAW resonator. a) and b) are representative optical microscope images of a resonator. The two interdigital transducers at the center are surrounded by two distributed reflectors for the wave confinement. Scale bars are 200 um (a) and 40 um (b). c) Representative scanning electron microscopy detail of a reflector (scale bar is 2 um).

References

1. Tichy, S. Spechtmeyer, M. Mittelbronn, E. Hattingen, J. Rieger, C. Senft, C. Foerch. J. Neuro-Oncology, **2016**, *126*, 361.
2. R. Shilton, M. Travagliati, F. Beltram, M. Cecchini. Advanced Materials, **2014**, *26*, 4941.
3. M. Agostini, G. Greco, M. Cecchini. Sensors and Actuators B: Chemical, **2018**, *254*, 1.
4. M. Agostini, M. Cecchini, Italian patent application #102019000000418 (accessed on 10 January 2019).

Abstract

86. Effects of Adhesive Parameters on Dispersion Characteristics of Ultrasonic Guided Waves in Composite Pipes

Li Juanjuan

Shanxi Key Laboratory of signal capturing, Processing, North University of China, Taiyuan 030051, China; jujunuc@gmail.com

---

The aim of the investigations presented here was to understand how the viscoelastic parameters of the adhesive layer affect the group velocity dispersion curve and attenuation dispersion curve of the double-layer composite pipes adhered by adhesive. These viscoelastic parameter types of adhesive (attenuation of the longitudinal wave-pα_L, attenuation of the shear wave-qα_T, thickness-d, density-nϱ) were utilized in order to generate a different degree of uncured adhesive layers. Group velocity dispersion curves, attenuation dispersion curves were obtained from these models at the frequency range 0–500 KHz. In particular, the group velocity and attenuation of L (0,2) and T (0,1) commonly used were compared and analyzed.

The results shown: (1) For the group velocity dispersion property, It is important to remark that little effect was caused by the change of viscoelastic parameters and frequency; (2) Generally, significant linear increase of guided wave attenuation occurs with increase of q, d, n, which is related to the frequency, suggesting that attenuation increase with the frequency for the same mode and attenuation value of longitudinal wave is greater than torsional modes at the same frequency. But the increase of p just causes slightly increase of longitudinal wave attenuation; (3) When d increase or n decreases, the number of guided wave modes become larger, causing difficulty on modal extraction and signal analysis.

Abstract

87. Bi-Dimensional Deflection Estimation by Embedded Fiber Bragg Gratings Sensors

Pasquale Di Palma [1], Giovanna Palumbo [1], Massimo Della Pietra [2], Vincenzo Canale [2], Mariagrazia Alviggi [2], Agostino Iadicicco [1,*] and Stefania Campopiano [1,*]

[1] Department of Engineering, University of Naples "Parthenope", Centro Direzionale Isola C4, 80143 Napoli, Italy

[2] Physics Department University of Naples "Federico II" and with I.N.F.N. Naples, Complesso Universitario Monte S. Angelo, 80126 Napoli, Italy

* Correspondence: iadicicco@ uniparthenope.it (A.I.); campopiano@uniparthenope.it (S.C.)

In this work, we present and discuss on a novel technique based on the classical beam theory for the deflection estimation of a bi-dimensional structure by means of strain measurements. We have used Fiber Bragg Gratings (FBGs) as strain sensors embedded in a rectangular multilayer panel to assess the method overcoming the existing difficulties in measuring the deflection directly. Thanks to this technique a real-time structural monitoring is possible both on small and large structure. Moreover, the use of the FBGs avoids the complex wiring typical of strain gauges. From the strain measured by the FBGs, the curvature function has been evaluated as a polynomial function with the coefficients obtained by least mean square analysis. Then, the deflection also is expressed in polynomial form where the coefficients are estimated by means of simple arithmetic operations on the strain polynomial coefficients. The results obtained with this procedure have been compared with those provided by direct deflection measurements by means of a mechanical comparator.

Experimental results show good agreement between the deflection indirectly measured by the FBGs and that directly measured by the mechanical comparator, and a resolution of few tens of microns has been reached over a surface of the order of 1 m^2.

Abstract

88. Chimera Protein Based Disposable Biosensor for the Electrochemical Monitoring of Polyphenolic Compounds

Daniel Izquierdo-Bote [1], María Begoña González-García [1], Alessandra Piscitelli [2], Ilaria Sorrentino [2], Paola Giardina [2], David David Hernández-Santos [1], Pablo Fanjul-Bolado [1,*] and Laura Fernández Llano [3]

[1] Metrohm Dropsens S.L edificio CEEI, Parque Tecnológico de Asturias, 33428 Llanera, Asturias, Spain
[2] Department of chemical Sciences, University Federico II, Naples, Italy
[3] Metrohm Dropsens
* Correspondence: pablo.fanjul@metrohm.com

The monitoring of contaminants in the marine environment presents an important task. Polycyclic aromatic hydrocarbons derived from polyphenols are among the most important contaminants present in the environment. These compounds are used in several industrial processes for manufacturing of chemicals such as pesticides, drugs and dyes, or in bleaching process of paper, and finally they are thrown to the sea from the offshore industry and also due to the leaks of fuel or oil from the ships.

In this work, a miniaturized electrochemical biosensor based on chimera proteins is presented for the detection of polycyclic aromatic hydrocarbons derived from polyphenols.

Electrochemical biosensors based on screen printed electrodes technology offers several advantages as robustness, simplicity, low-cost, fast-response time, and capability of miniaturization and "in-situ" detection.

Chimera proteins consist of a self-assembling moiety genetically fused to a specific protein that provide to the chimera, in one hand, adhesive properties of the self-assembling moiety and in the other hand the specific recognition ability of the target protein. Herein a fungal class I hydrophobin works as self-assembling moiety and a fungal laccase as recognition element. The chimera protein is provided with an enhancement of the sensibility to polyphenolic compounds respect to the free laccase, due to its stable anchoring onto the electrode surface with a precise orientation.

In the proposed biosensor enzymatic specific recognition is combined with electrochemical detection. The sensor performance was compared.

Abstract

89. Chinese Traditional Musical Instrument Evaluation Based on a Smart Microphone Array Sensor

Kun Li

Shanxi Key Laboratory of Signal Capturing and Processing, North University of China; lk_nuc@163.com

For Chinese traditional musical instruments, the general subjective evaluation method by experts is not cost-effective and is limited by fewer and fewer experts, meanwhile a clear physical law for musical instruments evaluation is very hard to established by physicists. Considering the effectiveness solution of artificial neural networks (ANNs) for complex system, for a Chinese lute case, a neural network based 8-microphone array is implemented and applied to correlate the objective instrument acoustic features measurement with expert subjective evaluations in this paper. The acoustic features were recorded by a nonuniform linear microphone array sensor and extracted as the constant-Q transform coefficients (CQTs), Mel-frequency cepstral coefficients (MFCCs) and correlation coefficients between each microphone (CCs) for the BP neural network input. The acoustic library establishment, acoustic features extractions, and deep learning model for Chinese lutes evaluation are reported in this paper. All testing and validating combinations are evaluated by the trained neural network based microphone array, and a mean accuracy of 92.84% is achieved.

Abstract

90. Cleaning Assurance for Reusable Plastic Packaging using Ultraviolet Induced Fluorescence

Elliot Woolley * and Rosie Hill

Loughborough University

* Correspondence: e.b.woolley@lboro.ac.uk

Implementing reusable packaging systems is one approach that could reduce the global consumption of single use plastics. Clearly, it is important to ensure that reusable packaging undergoes a process of cleanliness assurance before it is refilled. This research seeks to demonstrate the feasibility of an optical sensing technique to provide this assurance for polymer drinks bottles. An ultraviolet illumination source (@370 nm) is used to induce fluorescence in both common polymer and fouling samples. The responses, captured by digital imaging, are processed to determine features that can be used to differentiate the packaging and fouling substances. Variation in signal intensity and differences in responses in the red, green and blue channels are identified as suitable features to enable detection of fouling. In particular the differences in signal from milk and high-density polyethylene appear to lend themselves to differentiation via this method of detection. The applicability of this technique for other types of fouling is also considered.

Abstract

91. Comparison of Underwater ECG Measurement between Voltage-Based and Current-Based Methods Using Hydrophobic Silicone Electrode

Yuri Togashi [1] and Akinori Ueno [2,*]

[1] Department of Electrical and Electronic Engineering, Tokyo Denki University
[2] Tokyo Denki University
* Correspondence: ueno@mail.dendai.ac.jp

With a view to future development of ECG monitoring system for underwater rehabilitation, compatibility of a hydrophobic silicone electrode containing sliver-silver chloride and measurement method (i.e., voltage-based or current-based) was examined in terms of signal to noise ratio (***SNR***) and detection accuracy of ECG R wave ($\boldsymbol{P}_{ACC\_R}$). Five-minute measurement of Lead-I ECG was conducted using each combination of electrode (i.e., conventional film-covered gel or hydrophobic silicone) and the measurement method in water-immersed condition from three subjects. Analysis of measured ECG revealed the following: (1) ***SNR*** calculated from mean peak voltage of R wave divided by root mean square of ECG baseline was higher on average in the voltage-based method. (2) $\boldsymbol{P}_{ACC\_R}$ calculated by the comparison to reference ECG obtained from on-land body part was also higher on average in the voltage-based method. The results indicated superior combination of the silicone electrode to the voltage-based method than to the current-based method.

Abstract

92. Denoising of MEMS Vector Hydrophone Signal Based on Empirical Model Wavelet Method

Huichao Yan * and Linmei Zhang

North University of China

* Correspondence: huichao.yan@outlook.com

Underwater acoustic technology is a major method in current ocean research and exploration, which support the detection of seabed environment and marine life. However, the detection accuracy is directly affected by the quality of underwater acoustic signals collected by hydrophones. Hydrophones are efficient and important tools for collecting underwater acoustic signals. The collected signals of hydrophone often contain lots kinds of noise as the work environment is unknown and complex. Traditional signal denoising methods, such as wavelet analysis and empirical mode decomposition, product unsatisfied results of denoising. In this paper, a denoising method combining wavelet threshold processing and empirical mode decomposition is proposed, and correlation analysis is added in the signal reconstruction process. Finally, the experiment proves that the proposed denoising method has a better denoising performance. With the employment of the proposed method, the underwater acoustic signals turn smoothly and the signal drift of the collected hydroacoustic signal is improved. Comparing the signal spectrums of other methods, the spectral energy of the proposed denoising method is more concentrated, and almost no energy attenuation occurred.

Abstract

93. Design and Characterization of a Pressure Sensor Based on FBG on Steel Substrate

Vincenzo Marletta [1,*], Bruno Andò [1], Salvatore Baglio [1], Antonio Pistorio [1], Enza Giangreco [2], Marco Alessi [2], Davide Storelli [2], Alessio Camillò [2], Angelo Borzì [3] and Francesca Calabrese [4]

[1] Department of Electric Electronic and Information Engineering (DIEEI), University of Catania, Italy
[2] Engineering Ingegneria Informatica S.p.A.
[3] Idragest s.r.l.
[4] Apphia s.r.l.
***** Correspondence: vincenzo.marletta@dieei.unict.it

Water leak detection systems is of increasing interest because of decreasing water reserves and increasing deterioration or damage to the distribution systems, which involve a significant economic loss for the water network managing authorities.

In this paper a new optical, Fiber Bragg Grating (FBG) based, pressure sensor is presented. The sensor adopts a 500 μm thick circular stainless steel (316L) membrane with attached a FBG sensor to measure the strain exerted by the pressure (inside the monitored pipe). The membrane thickness has been suitably designed to assure a linear response in the range of pressure of interest. A second FBG sensor is used for the sake of temperature compensation. The sensor is thought to be used in a multi parametric multi-sensor system aimed at the detection of water leakages in potable water networks. The sensor has been experimentally characterized on a reference plant in the range of pressure 0–6 bar. Main metrological characteristics of the lab-scale prototype developed are: a sensitivity of 0.314 nm/bar, an accuracy of about 39 mbar and a resolution of about 1.5 mbar.

Abstract

94. Design of a Force/Tactile Sensor for Robotic Grippers

Marco Costanzo, Giuseppe De Maria, Ciro Natale and Salvatore Pirozzi *

Università degli Studi della Campania "Luigi Vanvitelli", Dipartimento di Ingegneria, Via Roma, 29, 81031 Aversa, Italy

* Correspondence: salvatore.pirozzi@unicampania.it

This paper presents the design of a new force/tactile sensor for robotic applications. The sensor is suitably designed to provide the robotic grasping device with a sensory system mimicking the human sense of touch, namely, a device sensitive to contact forces, object slip and object geometry. This type of perception information is of paramount importance not only in dexterous manipulation but even in simple grasping task, especially when objects are fragile and deformable, such that only a minimum amount of grasping force can be applied to hold the object without damaging it. Moreover, sensing only forces and not moments can be very limiting to securely grasp an object when it is grasped far from its center of gravity. Therefore, perception of torsional moments is a key requirement of the designed sensor. Furthermore, the sensor is also the mechanical interface between the gripper and the manipulated object, therefore its design should consider also the requirements for a correct holding of the object. The most relevant of such requirements is the necessity to hold a torsional moment, therefore a soft distributed contact is necessary.

Abstract

95. Development of a Rapid and Simple Sensor for Determination of Catalase Activity in Real Samples

Daniel Izquierdo-Bote [1], María Begoña González-García [1], David David Hernández-Santos [1], Pablo Fanjul-Bolado [1,*] and Laura Fernández Llano [2]

[1] Metrohm Dropsens S.L. edificio CEEI, Parque Tecnológico de Asturias, 33428 Llanera, Asturias, Spain
[2] Metrohm Dropsens
* Correspondence: pablo.fanjul@metrohm.com

It is well-known that catalase is an enzyme present mammalian tissues with antioxidant activity. The importance of this enzyme lies in it can catalyze the reaction that degrades hydrogen peroxide into water and oxygen. Therefore, catalase activity is one of the redox parameters related to oxidative stress, and antioxidant activity. In this way, its determination is widely use in clinical assays, since a raised catalase activity level in serum or blood may means the presence of several diseases. In this work we present a novel, integrated, low-cost, small, portable and rapid electrochemical sensor has been developed for the detection of the catalase activity using screen-printed electrodes that could be used as a diagnostic tool. With this device and a very simple methodology, the detection of catalase activity has been carried out employed smaller times than in the conventional methods that usually requires high-cost instrumentation, need specialized personnel to carry out the assays and control the equipment and are time-consuming. Therefore, ES is shown as an interesting alternative to those conventional methods, due to their excellent features, such as robustness, simplicity, low-cost, fast-response time and capability of miniaturization and "in-situ" detection.Herein, a simple and fast method for the electrochemical detection of catalase activity using disposable screen-printed electrodes is presented. A portable reader is programmed with the electrochemical method and adequate calibration plot. The electrochemical behavior of this sensor was carefully evaluated assessing aspects such as sensitivity, limits of detection and reproducibility.

Abstract

96. Identification of Dynamic Models for Temperature Sensors in Hyperthermic Chemotherapy

Vlad Muresan [1,*], Ramona Galatus [2], Daniel Moga [1], Nicoleta Stroia [1] and Corneliu Lungoci [3]

[1] Automation Department, Technical University of Cluj-Napoca, 400114 Romania; daniel.moga@aut.utcluj.ro (D.M.); nicoleta.stroia@aut.utcluj.ro (N.S.)

[2] Basis of Electronics Department, Technical University of Cluj-Napoca, 400114 Romania; ramona@bel.utcluj.ro

[3] Department of Surgery, "Iuliu Hatieganu" University of Medicine and Pharmacy Cluj-Napoca, 400000 Romania; corneliu.lungoci@umfcluj.ro

* Correspondence: vlad.muresan@aut.utcluj.ro

Abstract: The temperature sensors are essential components of a hyperthermic chemotherapy (HIPEC) systems. The availability of accurate models for sensor dynamics is instrumental for identifying the models for other blocks of the system. The development of accurate dynamic models is enabling the design of high performance control strategies for HIPEC equipment. This paper proposes the modelling of the heat transfer for a measurement probe which is immersed in liquid based on a complete modelling of its geometry and material properties in COMSOL. A good matching between the values obtained through simulation and the values recorded from the sensor prototypes demonstrates the validity of the simulation approach, enabling the characterization of the dynamics of a complete temperature probe setup (transducer, conductive wires, stainless steel capsule, protective tube) before the manufacturing and the assembly of the probe. Such an approach can support the investigation and the optimization of the sensor dynamics through different geometries and using different materials.

Keywords: sensor model analysis**;** thermal sensors; medical sensor applications

Abstract

97. Sensitive and Selective NH_3 Detection under High Humidity Using Electrostatically Formed Nanowire (EFN) Transistor

Yossi Rosenwaks [1,*], Niharendu Mahapatra [2], Anjan Bhukta [3], Michal Shach-Caplan [4], Izhar Ron [5], Hagai Sharabi [5] and Yossi Hayon [3]

[1] Faculty of Engineering, Tel-Aviv University
[2] Tel Aviv University
[3] Faculty of Engineering, Tel Aviv University
[4] Tower-Jazz
[5] Israel Institute for Biological Research
* Correspondence: yossir@tauex.tau.ac.il

For the past several decades, there is a growing demand for the development of low-power gas sensing technology for the selective detection of volatile organic compounds (VOCs), important for monitoring safety, pollution and healthcare. Although there are several categories of gas sensors, most of them suffers from the limitation of chip-scale miniaturization and low-power operation. By far, complementary metal–oxide–semiconductor (CMOS) compatible silicon nanowires (SiNWs)-based field-effect transistor technology have emerged as a promising candidate in overcoming power consumption, size limitations, and sensitivity. We present the selective detection of various VOCs using the electrostatically formed nanowire (EFN) transistor without any surface modification of the device. Selectivity towards specific VOC is achieved by training machine-learning based classifiers using the calculated changes in the threshold voltage and the drain-source on current, obtained from systematically controlled biasing of the surrounding gates (junction and back gates) of the field-effect transistors (FET). Specific biasing of the device has recently shown superb sensitivity to Ammonia and other molecules under very high humidity conditions. This makes the EFN platform a selective sensor, working under ambient conditions and room temperature, which is suitable for mass production and low-power sensing technology.

Abstract

98. ECOCAPTURE: Eye Tracking Access to Apathy in Real-Space Ecological Environment. Gaze Behavior in Frontotemporal Dementia

Pierre Mullot [1,2,*], Bénédicte Batrancourt [1], Aymen Mousli [1,2], Antoni Valero-Cabre [1], Frédéric Marin [2], Pierre Pouget [3] and Richard Levy [1,4]

[1] FrontLAB, Inserm U 1127, CNRS UMR 7225, UPMC Paris 06 University, UMR S1127, Sorbonne University, Brain and Spinal Cord Institute (ICM), Hôpital Pitié-Salpêtrière, Paris, France
[2] Sorbonne University, Université de Technologie de Compiègne, CNRS, UMR 7338 Biomechanics and Bioengineering, Compiègne, France
[3] Inserm U 1127, CNRS UMR 7225, UPMC Paris 06 University, UMR S1127, Sorbonne University, Brain and Spinal Cord Institute (ICM), Hôpital Pitié-Salpêtrière, Paris, France
[4] Department of Neurology, Behavioural Neuropsychiatry Unit, Institute of Memory and Alzheimer's Disease (IM2A), Pitié-Salpêtrière Hospital, Public Hospitals of Paris (AP-HP), Paris, France
* Correspondence: pierre.mullot@etu.utc.fr

Apathy, the quantitative reduction of voluntary or goal-directed behavior [1,2] is a major criterion for the clinical diagnosis of the behavioral variant of frontotemporal dementia (bvFTD) [3,4]. We have developed ECOCAPTURE, a method aimed to assess apathy in a quantitative and objective way, in ecological condition [6]. ECOCAPTURE consists in the recording of patient's behavior with video and sensor-based acquisition system (accelerometer, eye-tracking glasses (ETG)). Here, we analyzed the capacity of bvFTD patients and age-matched healthy controls (HC) to explore a waiting room. To this end, participants wore ETG and eye movements were quantified. The neuropathology of the bvFTD mainly affects the frontal lobes. Within the frontal lobe, the frontal eye field (FEF) is a key area contributing to initiate and control the execution of voluntary eye movements [7]. Therefore, we hypothesis that voluntary eye movements initiation will be reduced in bvFTDs. We present preliminary results in 5 bvFTDs and 5 HCs. Our analyses identified several promising metrics discriminating bvFTD from HC, such as lower saccade frequency for bvFTD, reflecting to reduced exploration abilities. Furthermore, contrary to HC who present similar exploration patterns, bvFTD gaze distribution is highly variable reflecting eye movements disorders due notably to FEF deterioration.

References

1. Levy R, Dubois B. Apathy and the functional anatomy of the prefrontal cortex–basal ganglia circuits. Cerebral cortex, **2005**, 16(7): 916–928.
2. Robert P, Lanctôt K L, Agüera-Ortiz L, et al. Is it time to revise the diagnostic criteria for apathy in brain disorders? The 2018 international consensus group. European Psychiatry, **2018**, *54*: 71-76.
4. Pasquier F, Lebert F, Lavenu I, et al. The clinical picture of frontotemporal dementia: diagnosis and follow-up. Dementia and geriatric cognitive disorders, **1999**, 10(Suppl. 1): 10-14.
3. Rascovsky K, Hodges J R, Knopman D, et al. Sensitivity of revised diagnostic criteria for the behavioural variant of frontotemporal dementia. Brain, **2011**, 134(9): 2456-2477.
5. Piguet O, Hornberger M, Mioshi E, et al. Behavioural-variant frontotemporal dementia: diagnosis, clinical staging, and management. The Lancet Neurology, **2011**, 10(2): 162-172.
6. Levy R, Batrancourt B, Ferrand-Verdejo J, Lecouturier K, Azuar C, Dubois B. What is apathy in frontotemporal dementia? An ecological way to assess apathy by video and sensor-based data acquisition system. 11th International Conference on Frontotemporal Dementias, 11-14 Nov 2018, Sydney, Australia.

7. Vernet M, Quentin R, Chanes L, et al. Frontal eye field, where art thou? Anatomy, function, and non-invasive manipulation of frontal regions involved in eye movements and associated cognitive operations. Frontiers in integrative neuroscience, **2014**, *8*: 66.

Abstract

99. ECOCAPTURE: Quantifying Apathy in Frontotemporal Dementia with Eye Tracking Measures Performed in Real-Space Ecological Environment

Aymen Mousli [1,2,*], Bénédicte Batrancourt [1], Pierre Mullot [1,2], Raffaella 'Lara' Migliaccio [1], Pierre Pouget [3], Frédéric Marin [2], Antoni Valero-Cabre [1] and Richard Levy [1,4]

[1] FrontLAB, Inserm U 1127, CNRS UMR 7225, UPMC Paris 06 University, UMR S1127, Sorbonne University, Brain and Spinal Cord Institute (ICM), Hôpital Pitié-Salpêtrière, Paris, France
[2] Sorbonne University, Université de Technologie de Compiègne, CNRS, UMR 7338 Biomechanics and Bioengineering, Compiègne, France; pierre.mullot@etu.utc.fr
[3] Inserm U 1127, CNRS UMR 7225, UPMC Paris 06 University, UMR S1127, Sorbonne University, Brain and Spinal Cord Institute (ICM), Hôpital Pitié-Salpêtrière, Paris, France
[4] Department of Neurology, Behavioural Neuropsychiatry Unit, Institute of Memory and Alzheimer's Disease (IM2A), Pitié-Salpêtrière Hospital, Public Hospitals of Paris (AP-HP), Paris, France
* Correspondence: aymen.mousli@etu.utc.fr

Apathy, the quantitative reduction of voluntary or goal-directed behaviors [1,2] is a major criterion for the clinical diagnosis of the behavioral variant of frontotemporal dementia (bvFTD) [3,4]. The assessment of this neuropsychiatric syndrome is often biased by subjectivity. To overcome these limitations, we have developed ECOCAPTURE, an evaluation program to assess apathy with objective quantitative measures collected in real space and ecological environment [6]. We present preliminary data of exploratory eye movements recorded in 6 bvFTD patients compared to 5 age-matched healthy controls (HC). The neuropathology of the bvFTD mainly affects the frontal lobes. Within the frontal lobe, the frontal eye field (FEF) is a key area contributing to initiate and control the execution of voluntary eye movements [7]. Hence, we hypothesized that bvFTDs patients would show impairments in the initiation of saccades compared to HCs. Our analyses identified several promising metrics such as the saccade frequency, which proved able to discriminate impaired exploratory behavior in bvFTDs compared to HCs. More specifically, bvFTD patients showed fewer eye movements compared to healthy controls during a 7-minute session. We hypothesize that straight forward saccadic measures could be used to diagnose or follow the course of apathy in bvFTD patients.

Abstract

100. Effect of Graphene Oxide Modification on a DNA Biosensor Developed for the Detection of Methylated DNA Associated with Cancer

Eliska Sedlackova [1,*], Lukas Richtera [1], Pedro Estrela [2] and Vojtech Adam [1]

[1] Mendel University in Brno
[2] University of Bath
* Correspondence: eliska.sedlackova@gmail.com

Methylated DNA is a covalent post-translational modification, which plays a crucial role in pathological and physiological processes including several diseases, such as cardiovascular disease, diabetes or cancer. Despite that, methylated DNA presents a new generation of biomarkers, which brings a promising alternative for using in point-care diagnostic. Regarding this fact, DNA based electrochemical sensors enable fast, reliable, low-cost, time-consuming and efficient detection. The application of these biosensors as possible alternatives for the determination of methylated DNA is recently growing. Therefore, a biosensor for the determination of methylated DNA was fabricated. This study was aimed to develop an efficient biosensor, with an amplified electrochemical signal which is suited for the detection of the low-level concentration of methylated DNA. The bare gold electrode was first covered with the graphene oxide modified with gold, silver and copper nanoparticles. These composites have a strong affinity to DNA probe and their effect on the sensitivity and selectivity of the biosensor was investigated. The developed biosensor shows promising analytical characteristics with a wide detection linear range. The electrochemical impedance spectroscopy (EIS) was used to detect the hybridization of the DNA probe with methylated DNA target.

Abstract

101. Electrolyte Gated Organic Field Effect Transistors for Chemical Monitoring of Living Cells

Jérémy Le Gall, Flavien Mouillard, Roberta Brayner, Giorgio Mattana, Vincent Noel and Benoit Piro *

University Paris Diderot—ITODYS, Paris, Franch
* Correspondence: piro@univ-paris-diderot.fr

Numerous progresses have been made over the years in microfabrication techniques, allowing laboratories to develop organic thin film transistors (OTFTs). Among them, Organic Electrochemical Transistors (OECTs) have mostly been used for cell monitoring while Electrolyte Gated Organic Field Effect Transistors (EGOFETs) have never been described for that kind of application. However, these transistors seem perfectly adapted for this because they can operate directly in a cellular culture medium, thanks to the conventional dielectric layer being replaced here by an electrolyte. They are also expected to be more sensitive than OECTs due to their much higher *on/off* ratio (several thousands instead of several tens).

In this work, we aim to demonstrate that monitoring microalgae photosynthesis is possible through the direct measurement of O_2 production thanks to its electroreduction on the EGOFET's gate. Such monitoring has already been followed using conventional amperometric setups, but EGOFETs are able to greatly amplify the response due to the intrinsic amplification ability of transistors. The idea here is to trap microalgae within a thin alginate hydrogel grafted on the platinum gate. While doing photosynthesis, microalgae will produce O_2 that can be electroreduced on the gate; such electron transfer is expected to drastically change the gating effect and generate a strong drain current change. Beyond this proof of concept, a possible application is environmental monitoring of pollutants cocktails through their deleterious influence on the metabolism of living organisms.

Abstract

102. Engineered Lab-on-Fiber SERS Optrodes Based on Nanosphere Lithography

Giuseppe Quero [1,*], Gianluigi Zito [2], Stefano Managò [2], Francesco Galeotti [3], Marco Pisco [1], Anna Chiara De Luca [2] and Andrea Cusano [1]

[1] Optoelectronic Division—Eng. Department, University of Sannio, 82100 Benevento, Italy
[2] Institute of Protein Biochemistry, National Research Council, 80131 Napoli, Italy
[3] Institute for Macromolecular Studies, National Research Council, 20133 Milan, Italy
* Correspondence: giuseppe.quero@unisannio.it

We report on our activities related to the development of repeatable surface enhanced Raman scattering (SERS) probes realized onto the optical fiber tip (OFT) through nanosphere lithography. We demonstrated that nanosphere lithography allows to decorate the OFTs with various periodic structures with feature sizes down to the submicron scale at low fabrication costs. In order to engineer and optimize the SERS probes, we first evaluated the SERS performances pertaining to different patterns with different nanospheres diameters and gold thicknesses. The analysis allowed us to identify the most promising SERS platform, exhibiting an Enhancement Factor of 4×10^5 and a SERS measurements variability lower than 10%. The reproducibility of the SERS enhancement was thoroughly evaluated. We addressed also the limitations related to the use of the same optical fiber for both illumination and light collection by selecting a commercial optical fiber with pure silica core of 200 μm diameter and high numerical aperture (i.e., 0.5) with a good trade-off in terms of high excitation/collection efficiency and low silica background. Current activities are devoted to the probe functionalization for protein detection. In particular, major efforts are devoted to realize Lab-on-fiber SERS probes for human Thyroglobulin, a protein marker of differentiated thyroid cancer.

Abstract

103. Enhanced Performance of GCE/N-Reduced Graphene Oxide-Au Nanocomposite in Dopamine Sensing

Daria Minta, Piotr Wiench and Grażyna Gryglewicz *

Faculty of Chemistry, Wrocław University of Science and Technology, Poland

* Correspondence: grazyna.gryglewicz@pwr.edu.pl

The reduced graphene oxide (rGO) and nitrogen-reduced graphene oxide (N-rGO) were electrochemically coated with gold nanoparticles and compared as the modifier of a glassy carbon electrode (GCE) for dopamine (DA) electrochemical sensors. The rGO and N-rGO were prepared by reduction of graphene oxide (GO) under hydrothermal conditions. Urea was applied as a nitrogen dopant. The modified GCEs were tested as working electrodes in the electrochemical DA detection in the presence of ascorbic and uric acids. Initially, the working parameters of sensors in a pure dopamine solution were determined. The GCE/N-rGO-Au electrode exhibited a lower limit of detection compared with the GCE/rGO-Au (385 vs. 700 nM). Both sensors had a wide linear range of 1–100 μM and high sensitivity of 0.78 μA/μM for GCE/N-rGO-Au and 1.78 μA/μM for GCE/rGO-Au. The presence of ascorbic and uric acids in the solution resulted in a decrease in the intensity of the DA oxidation, maintaining an acceptable limit of detection. This study showed that the surface modification of the graphene materials with gold nanoparticles allows to obtain satisfactory working parameters of DA sensors. The GCE/N-rGO-Au demonstrated the superior performance in the DA sensing due to a homogeneous distribution of gold nanoparticles on the surface of the N-doped graphene material.

Abstract

104. Exploiting Several Buffer Layers in SPR D-Shaped POF Sensors Based on Gold Film for Different Applications

Nunzio Cennamo [1], Paola Zuppella [2,*], Francesco Arcadio [1] and Luigi Zeni [1]

[1] Department of Engineering, University of Campania L. Vanvitelli, Aversa Italy
[2] Institute for photonics and nanotechnologies (IFN)–National Research Council (CNR), Padova, Italy
* Correspondence: paola.zuppella@pd.ifn.cnr.it

Surface plasmon resonance bio–chemical sensors in optical fibers are suitable for on-site and real-time monitoring of different analytes, then they play an important role in many research fields. Many solutions have been proposed in order to optimize the performances of the SPR sensors in terms of throughputs, sensitivity and robustness. We present a comparative study of three optical sensing platforms based on surface plasmon resonance (SPR) in plastic optical fibers (POFs). The proposed sensors consist of a D–shaped POF sensing area, where the exposed core is covered by a photoresist layer, used as intermediate layer between the fiber's core and the metal (gold) film. The photoresist deposited on the exposed core in the D–shaped POF region, is pivotal in order to improve the performances of the sensor in terms of sensitivity. In particular, we have compared the performances of three different buffer layers based on the following photoresist: Microposit SU-8 3005, Microposit S1813 before and after the expiry date.

Abstract

105. Fiber Optic Sensors Integrated in Aircraft Landing Gears for Load Monitoring

Antonio Iele [1], Marco Leone [1], Marco Consales [1,*], Giovanni Vito Persiano [1], Angela Brindisi [2], Salvatore Ameduri [2], Antonio Concilio [2], Monica Ciminello [2], Antonio Apicella [3], Francesco Bocchetto [3] and Andrea Cusano [1,*]

[1] Optoelectronics Group, Department of Engineering, University of Sannio, Benevento, Italy
[2] Adaptive Structure Division, Italian Aerospace Research Center, Capua (CE), Italy
[3] Magnaghi Aeronautica S.p.A., Napoli, Italy
* Correspondence: a.cusano@unisannio.it (A.C.); consales@unisannio.it (M.C.)

This paper deals with the development of a novel Fiber Bragg Grating (FBG) sensors system, to be integrated on aircraft landing gears (LGs), for remote and real time load monitoring. Several FBG strain sensors were integrated on different components (mainly axles and main fitting) of both the Main and Nose gears of a true aircraft (i.e., a twin-engine, 10-seat, 4.8 t helicopter) and exposed to numerous qualification lab tests where the load applied to the gears was varied in the range 0–20 kN. To this aim, the gears were mounted on a 25 kN hydraulic press, that changed the shock absorber route from 0 mm up to 200 mm (corresponding to the maximum take-off weight, ~4600 kg). Experimental results here reported are very encouraging and demonstrate the great potentialities of FBG sensor technology to be employed for aerospace applications, and in particular for remote and real time load measurements on aircraft landing gears.

Abstract

106. Getting Insight into Enzymes Kinetics and Thermodynamics via Theoretical Models in Protein-Film Square-Wave Voltammetry

Milkica Janeva, Viktorija Maksimova and Rubin Gulaboski *

University Goce Delcev

* Correspondence: rubin.gulaboski@ugd.edu.mk

We present in this work several relevant theoretical models of Protein-film square-wave voltammetry of uniformly adsorbed molecules of redox enzymes. Theoretical consideration of several one-electron step and two-electron step mechanisms that are coupled to preceding, follow up or regeneration (catalytic) chemical steps under conditions of square-wave voltammetry reveal many new aspects, especially by enzymatic electrode reactions featuring fast electron transfer. We show in this work that the phenomena of "split net-SWV peak" and "quasireversible maximum", which are typical for simple protein-film reactions studied in square-wave voltammetry, are strongly affected by kinetics and thermodynamics of preceding, follow-up, or regenerative chemical steps. While we present plenty of relevant voltammetric situations useful for recognizing all relevant and most common protein-film mechanisms in square-wave voltammetry, we also propose several new approaches to get access to kinetics and thermodynamics of chemical steps in all those mechanisms. Most of the results in this work throw new insight into the features of protein-film systems that are coupled with chemical reactions.

Abstract

107. Improved Sensitivity of Urchin-Like ZnO Nanostructures with Added Two-Dimensional Electron Gas in MgZnO/ZnO Interfaces

So-Young Bak [1], Jeongseok Lee [1], Yoojong Kim [1], Se-Hyeong Lee [1], Kyoungwan Woo [1], Sanghyun Lee [2], Yoo-Seong Lim [1] and Moonsuk Yi [1,*]

[1] Department of Electronics Engineering, Pusan National University, Busan, Korea
[2] Department of Smart Hybrid Engineering, Pusan National University, Busan, Korea
* Correspondence: msyi@pusan.ac.kr

Metal oxide semiconductor gas sensors are used in various fields such as health and safety. Metal oxide semiconductor gas sensors detect a gas by resistance variation depending on a change rate of the electron depletion layer region and the semiconducting regions when exposed to the target gas. Three key requirements of gas sensors are selectivity, sensitivity, and speed. To improve these performances, various methods such as forming heterojunction with p-type metal oxide semiconductors and decorating noble metal catalysts have been studied.

Compared to the hydrothermal reaction, the vapor phase growth has advantages such as short fabrication time, thermal stability, and simple process. So, urchin-like ZnO nanostructures were grown at MgO particles by vapor phase growth. Urchin-like ZnO structures gas sensors were approximately 12 times more sensitive than pristine ZnO nanowires.

In this study, sensitivity is going to increase by using heterojunction of ZnO and MgZnO. When MgZnO is decorated by sol-gel method on ZnO nanostructures, the 2DEG region is generated in addition to the semiconducting region and the electron depletion layer, so that the sensitivity becomes higher than pristine samples. Growth morphology and atomic composition of gas sensors were confirmed by field-emission scanning electron microscopy (FE-SEM) and energy-dispersive X-ray spectroscopy (EDS).

Abstract

108. Investigating the Progressive Failure of Unsaturated Granular Soil through a Small-Scale Physical Slope Model and a High Spatial Resolution Distributed Strain Sensor

Reza Darban, Emilia Damiano *, Aldo Minardo, Lucio Olivares, Luciano Picarelli and Luigi Zeni

Università degli Studi Della Campania "L. Vanvitelli", Dipartimento di Ingegneria

* Correspondence: emilia.damiano@unicampania.it

The mechanism of slope failure is typically characterized by the development of a highly non-uniform strain field, which does not allow an easy prediction of the failure conditions. Usually, the process which will bring the slope to final collapse starts with local soil failure, which then leads to formation and propagation of a shear zone, and finally to general slope failure. This mechanical process is called progressive failure. However, information about this kind of mechanism in granular unsaturated slopes is still very poor. This paper reports the result of a flume test on a small-scale slope in a sandy soil. The research investigates the response to continuous rainfall of unsaturated loose granular soils resting on an impervious basal surface characterized by a change of the slope angle. The slope behaviour is investigated with the support of traditional sensors and high spatial resolution distributed strain sensors based on stimulated Brillouin scattering.

Abstract

109. Low-Cost Sensing with Plastic Optical Fibers—From Turbidity and Refractive Index to Chemical Sensing

Filipa Sequeira [1,2,*], Daniel Duarte [1,2], Rogério Nogueira [1] and Lúcia Bilro [1]

[1] Instituto de Telecomunicações, Aveiro, Portugal
[2] Physics Department, University of Aveiro, Aveiro, Portugal
* Correspondence: fsequeira@av.it.pt

The availability of low-cost sensing systems able to give a reliable output is urgently needed in day-to-day lives. The capability to bring high level technology to the ground level of common users, with no need for specialized knowledge and with simple instruments would be a great advance in the synergy between science and population. This can be accomplished with low-cost sensing systems which will be presented in this manuscript.

This research team works on the development of low-cost, smart optical platforms for in-line and real-time measurement of liquid properties and/or chemical contaminants, based in optical fiber technology using plastic optical fibers (POFs). With the collaboration of national and international research groups, the development of low-cost sensors for the measurement of turbidity, color, refractive index and water contaminants was possible. An online cloud platform was also developed which allows to store, analyze and display the infield sensors' data using wireless connectivity.

Sensors' principle of operation relies on the light intensity modulation-based sensing using both intrinsic and extrinsic configurations designed to have dependence to the parameter to measure. The presence of contaminants in water can be detected through the interaction of target analytes with selective layers that are deposited on the POFs, therefore acting as selective coatings. The binding between the target analyte and these selective coatings causes a variation in the refractive index of the layer which allows the detection and monitoring of the target contaminant(s).

Abstract

110. Low-Frequency Vibration Sensor with a Sub-Nm Sensitivity Using a Bidomain Lithium Niobate Crystal

Ilya Kubasov [1,*], Aleksandr Kislyuk [1], Andrei Turutin [1,2], Alexander Bykov [1], Dmitry Kiselev [1], Aleksandr Temirov [1], Roman Zhukov [1], Nikolai Sobolev [1,2], Mikhail Malinkovich [1] and Yuriy Parkhomenko [1]

[1] National University of Science and Technology MISiS, 119049 Moscow, Russia
[2] Department of Physics and I3N, University of Aveiro, 3810-193 Aveiro, Portugal
* Correspondence: kubasov.ilya@gmail.com

We present a vibration sensor based on a cantilever made of a single-crystalline lithium niobate (LiNbO3) plate with a bidomain ferroelectric structure. The sensitive element was made of a rectangular bidomain lithium niobate plate fastened as a cantilever in a polycrystalline alumina clamp. We used in the study a home-made piezoelectric shaker, as well as two different voltage measurement setups: a lock-in and an oscilloscope. The sensitivity of the sensor to sinusoidal vibrational excitations was measured in terms of displacement as well as of acceleration amplitude. We have shown a strongly linear behavior of the response with the vibrational displacement amplitude in the entire studied frequency range up to 150 Hz. The sensitivity of the produced sensor varies from minimum values of 20 μV/nm and 7 V/g at a low-frequency excitation of 23 Hz to peak values of 92.5 mV/nm and 2443 V/g at the mechanical resonance of the cantilever at 97.25 Hz. The smallest detectable vibration depended on excitation frequency and varied from 0.1 nm at frequencies above 48 Hz to 100 nm at 7 Hz. The high thermal and chemical stability of lithium niobate, as well as an efficient conversion of mechanical deformations to voltage, makes the bidomain lithium niobate crystals a promising material for highly sensitive applications, including low-frequency vibrational sensors able to withstand harsh environment and high temperature.

Abstract

111. Monitoring Bacterial Biofilm Formation Using LSPR Sensors for Biofilm Specific Drug Screening

Riccardo Funari *, Nikhil Bhalla, Kang-Yu Chu and Amy Q Shen *

Micro/Bio/Nanofluidics Unit, Okinawa Institute of Science and Technology Graduate University, 1919-1 Tancha, Onna-son, Okinawa 904-0495, Japan

* Correspondence: riccardo.funari@oist.jp (R.F.); amy.shen@oist.jp (A.Q.S.)

The intrinsic resistance against conventional antibiotics and cleaning procedures make microbial biofilms a crucial concern in both medicine and industrial processes. Current laboratory methodologies focus on macroscopic and mostly indirect characterization of mechanical and microbiological properties of biofilms. However, the kinetics of the biofilm formation is not well understood, while such information is critical to screen new biofilm-specific antibiotics and unveil how drugs and chemicals influence the biofilm formation.

Herein, we report the use of a localized surface plasmon resonance (LSPR) biochip for the real-time and label free monitoring of *E. coli* biofilm assembly on a nanoplasmonic hybrid material consisting of gold-glass mushroom-like structures. Our optical sensor system is capable to track, without any labelling or disrupting agent, the stages of biofilm formation in real-time by recording the wavelength shift in the LSPR resonance peak for 24 h with high temporal resolution. This valuable feature allows us to show how biofilm formation is affected by conventional antibiotics (i.e., kanamycin and ampicillin) as well as rifapentine, a molecule which prevents cell adhesion yet barely affecting bacterial viability and vitality. Furthermore, two conventional biofilms characterization techniques like crystal violet and viability staining are used to validate our results.

Our LSPR-based platform is simple, sensitive and flexible to detect in real-time the assembly of a complex biological structure like microbial biofilm. Moreover, it can be used on a wide range of clinically and industrial relevant bacteria, thus representing a promising device in biofilm characterization and drug screening.

Abstract

112. Nano- and Micro Material-Based Electrochemical Bioassays for the Non-Invasive Electrochemical Detection of HER2-ECD, a Breast Cancer Biomarker

Maria Freitas, Henri P. A. Nouws * and Cristina Delerue-Matos

REQUIMTE/LAQV, Instituto Superior de Engenharia do Porto, Politécnico do Porto, Rua Dr. António Bernardino de Almeida 431, 4200-072 Porto, Portugal

* Correspondence: han@isep.ipp.pt

Breast cancer is one of the leading causes of oncological deaths. Diagnostic techniques are in constant development but are far from ideal [1]. Screening and early diagnosis are crucial to increase the success of cancer patients' treatments and to improve the survival rate. The development of biosensors and bioassays for the detection of breast cancer biomarkers in serum can contribute to this success. In serum analysis, biomarkers that shed extracellular domains (ECD) in the peripheral blood (e.g., Human Epidermal growth factor Receptor 2 (HER2-ECD)) are important analytes. Electrochemical strategies based on the use of nano- or micromaterials can improve the assays' performance. The use of small size transducers, the reasonable short assay times and the low sample volumes are key features for the development of point-of-care (POC) devices [2].

Distinct electrochemical immunosensing strategies were developed for the analysis of HER2-ECD. A sandwich assay was performed using SPCEs modified with (1) gold nanoparticles (AuNP), (2) carboxylic acid functionalized multiwalled-carbon nanotubes (MWCNT) and gold nanoparticles or using (3) carboxylic acid-functionalized magnetic beads. The antibody-antigen interaction was detected using a secondary antibody labelled with alkaline phosphatase and 3-indoxyl phosphate combined with silver ions as the enzymatic substrate. The electrochemical signal of the enzymatically generated metallic silver was recorded by linear sweep voltammetry (LSV). The total assay time was 2 h 20 min. The obtained LODs were 8.5 ng/mL for SPCE-AuNP, 0.16 ng/mL for SPCE-MWCNT/AuNP and 2.8 ng/mL for SPCE-MBs.

Abstract

113. Novel Fabrication Technique of Superimposed LPG with Different Grating Pitches for the Simultaneous Detection of Refractive Index and Temperature

Cosimo Trono [1,*], Federico Valeri [1,2] and Francesco Baldini [1]

[1] Istituto di Fisica Applicata "Nello Carrara", Consiglio Nazionale delle Ricerche
[2] Università degli Studi di Firenze, Dipartimento di Fisica
* Correspondence: c.trono@ifac.cnr.it

Optical fiber sensors based on in-fiber Long Period Gratings (LPG) have attracted considerable interest in the context of environmental, chemical and biochemical sensing. LPG is characterized by a grating period in the range of hundreds of micrometer giving rise to the coupling between the fundamental core mode and a discrete set of forward propagating cladding modes. The specific coupling between the modes generates in the transmission spectrum a series of attenuation bands dependent on the grating pitch. In the present work is described a technique for the inscription of superimposed LPGs with different grating pitches, which allows the coupling to two different cladding modes whit resonant wavelengths within a relatively small wavelength band. These cladding modes will exploit different sensitivities to RI and temperature making it possible the simultaneous detection of these two parameters. LPGs are usually fabricated by using an excimer UV laser with emission at 248 nm, shaped by means of a slit, and the point by point technique, that allows to obtain a square-wave core RI modulation, although the sinusoidal modulation should theoretically give rise to better results. The writing technique here proposed is based on the writing of an almost-sinusoidal modulation of the core refractive index by sampling the sinusoidal function with small rectangular modulations obtained by a very small aperture slit (~30 μm). Although this technique do not give rise to significant advantages in the writing of a single LPG, is here demonstrated to be essential for the inscription of superimposed LPGs.

Abstract

114. Modeling Tools for the Optimization of Optical Fiber Tweezers

Reem Sweid [1,2,3,*], Sandra M. Rodrigues [2], Joana S. Paiva [2], Nunzio Cennamo [1], Luigi Zeni [1] and Pedro A. S. Jorge [2,*]

[1] Department of Engineering, University of Campania "Luigi Vanvitelli", Via Roma 29, Aversa 81031, Italy
[2] Instituto de Engenharia de Sistemas e Computadores, Tecnologia e Ciência (INESC), 4200-465 Porto, Portugal
[3] Physics and Astronomy Department, Faculty of Sciences, University of Porto, 4169-007 Porto, Portugal
* Correspondence: Reem.sweid@unicampania.it

Light can convey a force being heavily loaded with photons, although weak, this force is relatively large when applied on single atoms, molecules, or Nano-scaled organisms. An optical trap or "optical tweezer" is a device capable of applying piconewton sized forces on micro-sized dielectric objects using a highly focused light beam which can selectively impart force to atoms, to push or trap microscopic dielectric spheres or even entire, living, cellular organisms, inside biological media.in this work, we present a simulation and fabrication method for both the single mode and multimode optical fiber Tips for trapping and manipulation of microparticles and cells. In addition, we provided a characterization of the trapping forces and The backscattering of the electromagnetic wave which reflected on the particle surface and propagated back into the optical fiber core, this signal was then used for particle analysis. The results of the comparison between the simulated tweezers and the experimental validate the models used and enable them as tools to evaluate new configuration before they are fabricated. then we used the models to study improvement of the trapping forces, for the range where the target particles are on the Nanoscale. In particular, we designed a new optical trapping configuration based on plasmonic nanostructures which will be explored in future work.

Abstract

115. Observability Analysis for Parameter Identification of a Quadrotor

Rodrigo Munguía [1,*], Isidro Sarquis Urzua [2] and Antoni Grau [3]

[1] University of Guadalajara
[2] Autonomous University of Guadalajara
[3] Technical University of Catalonia
* Correspondence: rodrigo.munguia@upc.edu

This work presents the results obtained from a nonlinear observability analysis carried out in order to investigate the theoretical possibility of identifying all the model parameters of a quadrotor by mean of a single estimation process, from measurements that can be obtained directly from onboard sensors that are commonly available in that class of unmanned aerial vehicles. First, the kinematic and dynamic model of a quadrotor is presented. Then, in order to carry out the observability analysis, the state vector is augmented by considering the parameters to be identified as state variables with zero dynamics. From the analysis, the sets of measurements from which the model parameters can be estimated are derived. Also, a necessary condition that must be satisfied in order to obtain the observability results is given. According to the results, it should be feasible to identify all the model parameters of a quadrotor in the same estimation process, from measurements that can be obtained directly from onboard sensors.

Abstract

116. Optical Fiber Luminescent Aptasensor for the Detection of Hg^{2+} Ions in Aqueous Media

Nerea De Acha [1,*], César Elosúa [1,2] and Francisco J. Arregui [1,2]

[1] Public University of Navarra, Campus Arrosadia s/n, E31006, Pamplona, Spain
[2] Institute of Smart Cities, Campus Arrosadia s/n, E31006, Pamplona, Spain
* Correspondence: nerea.deacha@unavarra.es

A luminescence based optical fiber mercury (II) sensor fabricated with a fluorophore-labeled oligonucleotide sequence is presented in this work. Owing to its high affinity for Hg^{2+} ions, a thymine-rich aptamer has been utilized as recognition probe. It has been linked to the fluorophore Atto390, which, under the illumination of a LED at 365 nm, shows a luminescence emission at 460 nm. As in the presence of Hg^{2+} ions, T-Hg^{2+}-T mismatches are formed, an electron transfer mechanism between the fluorophore and these mismatches occurs, which induces a quenching of the luminescence emitted by the first one. Thus, monitoring that luminescent intensity allows to determine the Hg^{2+} ions concentration in aqueous media. With that purpose, the sensitive oligonucleotide sequence has been deposited onto the tip of a tapered 1000 μm-core optical plastic cladding fiber. The luminescent sensor thus obtained is capable of clearly detecting concentrations of 10^{-7} M Hg^{2+} ions in real time.

Abstract

117. Optical Filters Embedded Fiber-Optic Radiation Sensors for Radiotherapy Dosimetry

Kyoung Won Jang [1], Wook Jae Yoo [2], Hyun Young Shin [3] and Bongsoo Lee [3,*]

[1] Research Center, Dongnam Institute of Radiological and Medical Science, Busan 46033, Korea
[2] Radiation Technology & Research Center, Korean Association for Radiation Application, Jeongeup 56212, Korea
[3] School of Energy Systems Engineering, Chung-Ang University, Seoul 06974, Korea
* Correspondence: bslee@cau.ac.kr

In order to remove radiation induced emissions in fiber-optic radiation sensors, the subtraction method using a background optical fiber has been employed. However, this method requires a two-channel photo-detector to measure the light outputs from the fiber-optic radiation sensor and the background optical fiber respectively. And therefore, the uncertainty in measurement increases by using the additional channel of the photo-detector. In this research, an optical filter embedded fiber-optic radiation sensor was fabricated to spectrally remove the radiation induced emissions in total light output of the fiber-optic radiation sensor. To characterize the spectra of radiation induced emissions, the radiation induced emissions generated from a bare optical fiber were measured using a spectrometer according to depths of a water phantom. Also, percentage depth doses for gamma rays emitted from a Co-60 therapy unit were obtained using the optical filter embedded fiber-optic radiation sensor and the subtraction method based fiber-optic radiation sensor respectively.

Abstract

118. Optical Voltage Transducer for Embedded Medium Voltage Equipment: Design and Parameters Optimization

Letizia De maria [1,*], Daniele Bartalesi [1], Roberto Luigi Brambilla [1], Andrea Orrea [2] and Natale Claudio Pistoni [3]

[1] RSE S.p.A, Milan, Italy
[2] AME srl, Bagnara di Romagna (RA), Italy
[3] Optoelectronics and Fibre Optics Consultant, Milan, Italy
* Correspondence: Letizia.DeMaria@rse-web.it

An Optical Voltage Sensor prototype has been reported as suitable for potentially operate as embedded sensor in capacitive dividers for monitoring Medium Voltage in distribution networks. It is based on a retracing scheme, which consists of Lithium Tantalate (LiTO3) crystals used as optical transducers and on telecom standard single mode fibre components. Main features of this optical solution are a simple optical layout and potentially low cost, due to the use of standard telecom optical components. These features match some basic requirements for sensors integration in electrical equipment, as foreseen by next generation distribution network. It is also required a fault free operation of the sensor under fast impulsive voltage with amplitudes considerably higher than the typical operating values. In this work main results of a numerical and experimental investigation aimed to guarantee the OVS sensor survival under fast over-voltages are reported. A COMSOL model of the transducer has been used for optimizing the design of the optical layout. With the assessed design no electrical field disturbances within the transduction path has been detected. In particular, no critical electric field gradients were evidenced which could damage or deteriorate over time the performance of the OVS sensor. Test carried out under different configurations of the electric circuit confirmed the correct behaviour of the optical sensor even in the presence of strong over voltages. No damage of the device was detected. The high reproducibility of test results confirmed the functionality of the assembled optical prototype.

Abstract

119. Photoacoustic Detection of Short-Chained Hydrocarbon Isotopologues

Alain Loh [1,2] and Marcus Wolff [1,*]

[1] Hamburg University of Applied Sciences
[2] University of the West of Scotland
* Correspondence: marcus.wolff@haw-hamburg.de

We report, to our knowledge, the first optical detection of the main isotopologues of short-chained hydrocarbons. The sensor system is based on photoacoustic (also known as optoacoustic) spectroscopy (PAS, OAS). This technique takes advantage of the fact that absorbed electromagnetic radiation is partially transferred into kinetic energy via inelastic molecular collisions. This is equivalent to a temperature increase of the irradiated volume. If the radiation is modulated, a pressure wave with an amplitude proportional to the concentration of the absorbing molecules is generated, the so called PA (OA) signal. Two continuous wave (cw), thermoelectrically cooled (TEC), distributed feedback interband cascade lasers (DFB-ICLs) with emission wavelengths around 3.33 and 3.38 μm, respectively, serve as light sources. The PA signal is detected with a microphone and phase-sensitively amplified. The new sensor is applied for the stable carbon isotope selective analyses of methane (CH_4), ethane (C_2H_6) and propane (C_3H_8). We report first measurements of $^{12}C_2H_6$, $^{13}C^{12}CH_6$ and $^{13}C_2H_6$ as well as of $^{12}C_3H_8$ and $^{13}C^{12}C_2H_8$, all at approximate room temperature and atmospheric pressure. The listed isotopologues were selected because of their importance for numerous applications from atmospheric and planetary research to natural gas exploration.

Abstract

120. Piezoelectric Dual Axis Cantilever Sensor for Dynamic Low Force Measurements on an Open Source Based Platform

Juhani Virtanen *, Antti Vehkaoja and Sampo Tuukkanen

Faculty of Medicine and Health Technology, Tampere University (TUNI), P.O. Box 692, FI-33101 Tampere, Finland

* Correspondence: juhani.virtanen@tuni.fi

A piezoelectric cantilever force measurement system was developed with a dual axis mechanical cantilever probe, an analog amplifier and a digital signal processing unit. The cantilever probe arrangement was constructed from a lead zirconate titanate (PZT) piezo disc that was first cut into four different symmetric segments. Then a 33 mm long metal cantilever probe was attached to the segment apexes perpendicularly to the piezo disc plane. Further the segments were fixed to a frame from the opposite side of the apex. The signals of the piezoelectric sensing elements are amplified with a four-channel operational amplifier circuit having a voltage gain of 10 (20 dB) in each channel. The digital signal processing was implemented on Arduino Due hardware platform to perform the analog-to-digital conversion and the digital signal processing. A Labview software was made to provide an interface for the Arduino Due to visualize and capture the data on a computer. The system is capable of measuring radial forces at the probe tip in a range of 2 millinewtons.

Abstract

121. Plasmonic Nanostructures Integrated in Microfluidic Chips for the Sensitive SERS Detection of miRNAs

Alessandro Chiado' [1,*], Chiara Novara [1], Niccolò Paccotti [1], Paola Rivolo [1], Glenda Biasotto [2], Roberto Nisticò [3], Gerolama Condorelli [4,5], Vittorio de Franciscis [4], Francesco Geobaldo [1] and Fabrizio Giorgis [1]

[1] Department of Applied Science and Technology, Politecnico di Torino, Torino, Italy
[2] LIEC, Institute of Chemistry, São Paulo State University-UNESP, Araraquara, Brazil
[3] Department of Applied Science and Technology, Politecnico di Torino, Turin, Italy
[4] Institute of Endocrinology and Experimental Oncology of Italian National Research Council, Naples, Italy
[5] Department of Molecular Medicine and Medical Biotechnology, "Federico II" University of Naples, Naples, Italy
* Correspondence: alessandro.chiado@polito.it

Surface-enhanced Raman Scattering (SERS) is a leading technique for the development of innovative biosensors. Indeed, it can be used for the highly sensitive detection of biomolecules in complex biological samples, such as cell extracts or biofluids, taking advantage of plasmonic nanostructures. In this work, an overview of several SERS substrates based on different plasmonic nanostructures such as Ag-PDMS substrates, silvered porous silicon (pSi) on polydimethylsiloxane (PDMS) membranes, 3-D graphene-Ag based aerogels and flower-like Ag nanostructures is presented: each of these platforms have been used for biosensing applications. As a representative example, an elastomeric microfluidic multichamber chip, integrating porous silicon (pSi) membranes decorated with Ag nanoparticles, is here focused on the multiplex detection of miRNAs, short regulatory sequences involved in several diseases, including cancer. In order to exploit the SERS sensitivity, an innovative label-free protocol was developed. The effectiveness of the developed SERS sensing platform was demonstrated by detecting miR-222 into lung cancer cellular extracts, avoiding complex and expensive sample pre-treatments.

Abstract

122. Plasmonic Optical Fiber Sensors and Molecularly Imprinted Polymers for Food Safety Applications

Simone Marchetti [1,*], Maria Pesavento [1], Luigi Zeni [2] and Nunzio Cennamo [2]

[1] Department of Chemistry, University of Pavia, Via Taramelli n.12, Pavia, Italy
[2] Department of Engineering, University of Campania Luigi Vanvitelli, Via Roma n.29, Aversa, Italy
* Correspondence: simone.marchetti87@gmail.com

The presented optical-chemical sensor is based on a specific molecularly imprinted polymer (MIP) as a receptor, connected with surface plasmon resonance (SPR) transduction in a D-shaped plastic optical fiber (POF). As a proof of principle, furfural (furan-2-carbaldehyde, 2-FAL) is considered as a target analyte, due to its interest in the food industry, as for example wine production, in relation to its toxic and carcinogenic effect on the human beings, but also for its effects on flavor. POFs are especially advantageous for optical sensing purposes due to their excellent flexibility, easy manipulation, great numerical aperture, large diameter, and the fact that plastic is able to withstand smaller bend radii than glass. In this work, the optical platform is a multilayer structure realized starting from a planar surface of exposed core POF, embedded in a resin block (intrinsic D-shaped POF platform), with an optical buffer consisting of a photoresist layer and a gold nanolayer 60 nm thick. This sensing platform is easily and rapidly built up. The results showed that the proposed optical platform is able to selectively detect the presence of 2-FAL in aqueous media.

Abstract

123. Portable Immunosensor Based on Extended Gate—Field Effect Transistor for Rapid, Sensitive Detection of Cancer Markers

Chiara Baldacchini [1,2], Anna Rita Bizzarri [1,*], Antonino Francesco Montanarella [1], Chiara De Pascali [3], Leandro Lorenzelli [4], Francesco Parretti [5], Roger Cagliesi [5], Luca Francioso [3] and Salvatore Cannistraro [1]

[1] Biophysics, Nanoscience Centre, DEB, Università Degli Studi Della Tuscia, Largo dell'Università, 01100 Viterbo, Italy
[2] CNR-IRET, Institute of Research on Terrestrial Ecosystems, Via Marconi 2, 05010 Porano (TR), Italy
[3] CNR-IMM, Institute for Microelectronics and Microsystems, Via Monteroni, 73100 Lecce, Italy
[4] CMM-FBK, "Bruno Kessler" Foundation, Via Sommarive 18, 38123 Trento, Italy
[5] Synergie Cad Instruments, via Milano 15I/15L, 25032 Chiari (BS), Italy
* Correspondence: bizzarri@unitus.it

We present an immunosensor for rapid and sensitive detection of the p53 oncosuppressor protein and of its mutated form $p53_{R175H,}$ which are both valuable cancer biomarkers. The sensor is based on the accurate measurement of the source-drain current (I_{ds}) variation of a metal oxide semiconductor field-effect transistor (MOSFET) due to gate potential changing arising from charge release upon selective capture of the biomarker (antigen) by the complementary partner (antibody) immobilized on a sensing metallic surface connected to the gate electrode (extended gate: EG). Therefore, an unknown biomarker concentration can be correlated to the corresponding I_{ds} variation. For practical use and portability purpose, a high current resolution (which is needed to be competitive with standard immunoassays) should be also combined with compact dimensions of the final sensor device. To this aim, we have coupled our sensing surface (EG) and transduction element (MOSFET) with a microelectronic system composed of a precision voltage source (100 mV) connected to a Rshunt, which is, in turn, connected to the MOSFET drain electrode. The results and the sensitivity obtained by our EG-MOSFET based immuno-sensor are discussed in connection with the standard methods available in the literature.

Abstract

124. Position Measurement Based on Fisheye Imaging

Xianjing Li

Shanxi Key Laboratory of Signal Capturing and Processing, North University of China; Xianjing_Li@163.com

For the omnidirectional measurement, the collected images of large-angle fisheye lens need to be corrected and spliced before next procedure, which is complicated and inaccurate. In this paper, a direct position measurement method based on fisheye imaging is proposed for large-angle imaging without any image correcting and splicing. A nonlinear imaging system of fisheye lens is used to acquire the sequence images based on its distortion model, and the critical distortion features of the sequence images are extracted, which contains the position information. And a BP neural network is trained with the extracted image features of previous standard experimental dataset. Finally, the trained BP neural network is employed to measure the object's distance. Experimental results demonstrate show that the proposed method achieves simple close-object distance measurement with high robustness and a measurement error of ±0.5 cm. The proposed method overcomes the shortcomings of conventional measurement methods and expands the fisheye applications filed for omnidirectional measurement.

Abstract

125. Potential of Sumanene Modified with Boron and Nitrogen Atoms for Adsorption of Carbon Dioxide: DFT and SAPT Study

Stevan Armaković [1,*], Sanja J. Armaković [2], Sonja Skuban [1], Elvira Djurdjic [1], Stevan Jankov [1] and Zeljka Cvejic [1,*]

[1] Department of Physics, Faculty of Sciences, University of Novi Sad
[2] Biochemistry and Environmental Protection, Department of Chemistry, Faculty of Sciences, University of Novi Sad
* Correspondence: stevan.armakovic@df.uns.ac.rs (S.A.); zeljka.cvejic@df.uns.ac.rs (Z.C.)

Buckybowls are organic, curved and bowl-shaped molecules whose main representatives are corannulene and sumanene. Owing to their specific structural, reactive and adsorption properties, buckybowls are considered as possible future sensors of greenhouse gases. In this work density functional theory (DFT) and symmetry-adapted perturbation theory (SAPT) calculations have been utilized for the computational investigation of carbon dioxide (CO_2) adsorption by sumanene molecule modified with boron and nitrogen atoms. Within DFT calculations, several representative functionals, known for their applicability in cases when noncovalent interactions take part, have been used for calculations of binding energies. DFT calculations have been also used for detailed identification and quantification of noncovalent interactions formed between sumanene-based structures and CO_2. Selected spectroscopic properties have been obtained with DFT and time-dependent DFT calculations as well, with the goal to identify the significant changes induced by the presence of CO_2 molecule. SAPT calculations have been employed in order to decompose interaction energy into different components, which enabled us to identify the physical origins of interactions between sumanene-based structures and CO_2. Adsorption of CO_2 by coronene, sumanene's planar relative and frequently employed model structure for studying adsorption of carbon materials, has also been considered by the above mentioned calculations in order to understand the effects of curvature to adsorption properties.

Abstract

126. Real-Time Analysis of Electrolytes in Sweat through a Wearable Sensing Platform

Paolo Pirovano [1], Akshay Shinde [1], Paddy White [2], Gordon Wallace [3], Margaret McCaul [1] and Dermot Diamond [1,*]

[1] Insight Centre for Data Analytics, National Centre for Sensor Research Dublin City University, Glasnevin, Dublin 9, Ireland
[2] Shimmer, DCU Alpha, Old Finglas Rd, Glasnevin, Dublin 11, Ireland
[3] ARC Centre of Excellence for Electromaterials Science, University of Wollongong, Wollongong NSW 2522, Australia
* Correspondence: dermot.diamond@dcu.ie

The field of biochemical sensing is evolving from the use of bulky apparatuses to the development of miniaturized systems allowing personal sensing and point of care analysis. We have previously reported the SwEatch platform, which is capable of monitoring the concentration of sodium in sweat. Here we report further developments on the device: solid state, integrated ion-selective electrodes for Na^+, K^+ and Cl^- have been prepared, and their response and cross-interference behaviour in simulated sweat studied. Moreover, a platform with the capability of simultaneously acquiring data on multiple analytes has been developed. The platform accesses sweat emerging through the skin, drawing it across solid-state ion-selective electrodes by capillary action and towards a reservoir consisting of absorbent cellulose-based material. The electrolyte composition is monitored in real time by potentiometry. The sensor data is then digitised and transmitted via Bluetooth to a mobile phone or laptop. The platform has been employed in on-body trials during controlled exercise.

Abstract

127. Robot-Assisted Acupuncture

Kun-Chan Lan [1], Guan-Sheng Li [1] and Jun-Xiang Zhang [2,*]

[1] Department of Computer Science and Information Engineering, National Cheng Kung University, Tainan, Taiwan
[2] Institute of Medical Informatics, National Cheng Kung University, Tainan, Taiwan
* Correspondence: king841231@gmail.com

Acupuncture therapy is one of the main modalities of treatment in Traditional Chinese Medicine (TCM). Based on the different symptoms of the patient, needling or massaging is applied to the corresponding acupuncture points to relieve the symptoms. However, unless one has been trained for a long period of time, it is hard to remember all of the acupoint locations and corresponding symptoms, due to the complexity and diversity of the acupoints. We designed and implemented an acupoint localization system with a high accuracy through integrating multiple techniques including landmark detection, image deformation and the 3D morphable model (3DMM). In the case of mild symptoms (e.g., headache, sleep disorder), with the aid of our proposed system, the patient can quickly locate the corresponding acupuncture points for the application of massage, and relieve his/her symptoms without the help from TCM physicians.The proposed system includes four stages: symptom input (in which the user interacts with a chatbot to describe his/her symptom), symptom search (according to the symptom described by the user, a TCM database is mined and symptom-related acupuncture points are retrieved), acupuncture point localization and massage with the robot arm. Due to the space limitation, in this poster we focus on the description of acupoint localization and robot arm control. In addition, we explain our acupoint localization scheme based on a face model.

Abstract

128. Selection of Optimal Stabilizers for Silver Nanoparticles as Labels for Electrochemical Sensors

Elena Vladimirovna Dorozhko [1,*], Elena Ivanovna Korotkova [2] and Yekaterina Petrovna Khristunova [3]

[1] Assistant Professor of Tomsk Polytechnic University, Russia
[2] Professor of Tomsk Polytechnic University, Russia
[3] Graduate Student of Tomsk Polytechnic University, Russia
* Correspondence: elena-dorozhko@yandex.ru

In the past decade, electrochemical assays play a crucial role in the quantification of target molecules in clinical and biological specimens [1,2]. Metal nanoparticle–antibody conjugates are often used as electrochemical markers in applications like electrochemical assays because of their biospecifically binding to target molecules. Among metal nanoparticles, silver nanoparticles (SNPs) have received considerable attention due to their attractive physico-chemical properties [3]. Multiple factors influence the stability and bioactivity of SNPs before binding with biomolecules. Specific attention was paid to optimization of the procedure of synthesis of SNPs colloids, but also to minimization effect of the stabilizer on the electrochemical properties of nanoparticles.

The purpose of this study was to compare the stabilizing effect of BSA and starch on SNPs, obtained by two methods as a signal-forming label for electrochemical analysis.

In the future, the main idea of this research is to develop an electrochemical sensor for the quantitative detection of antibodies wherein SNPs will be used as direct signaling markers, and their signal would be recorded by voltammetry.

Abstract

129. Sensing Features of Arc-Induced Long Period Gratings

Flavio Esposito, Anubhav Srivastava, Stefania Campopiano * and Agostino Iadicicco *

University of Naples Parthenope, Department of Engineering

* Correspondence: campopiano@uniparthenope.it (S.C.); iadicicco@uniparthenope.it (A.I.)

The Long Period Grating (LPG) is a device consisting of a periodic perturbation of the refractive index and/or the geometry of the optical fiber. As a result, the transmission spectrum of the fiber shows attenuation bands centered at discrete wavelengths, each one corresponding to the coupling between the core mode and a different cladding mode. The shape of the spectrum and the resonance wavelengths of the attenuation bands are sensitive to several parameters, as for example: temperature, strain, bending and surrounding refractive index (SRI). In this work, we report a systematic investigation about the sensitivity of LPGs fabricated in standard SMF28 fiber by using a simple technique based on the electric arc discharge. Several gratings were fabricated with period Λ in range 330–630 μm and characterized towards changes in the SRI, temperature and strain conditions. Wide tuning of the sensitivities is reported, with maximum values of −6391.7 nm/RIU, 95.5 pm/°C and 2.0 pm/με, respectively, for SRI, temperature and strain. These results permit the proper selection of the fabrication parameters in order to have the desired sensing features for a specific application.

Abstract

130. Sensing of Copper(II) by Immobilized Ligands: Comparison of Electrochemical and Surface Plasmon Resonance Transduction

Maria Pesavento [1,*], Nunzio Cennamo [2], Biesuz Raffaela [3], Antonella Profumo [3] and Daniele Merli [3]

[1] Department of Chemistry, University of Pavia, Pavia, Italy
[2] Department of Engineering, University of Campania Luigi Vanvitelli, Aversa, Italy
[3] Dipartimento di Chimica, Università di Pavia, Pavia, Italy
* Correspondence: maria.pesavento@unipv.it

Two sensors for the detection of the metal ion Copper(II) (Cu(II)), based on the same sensing receptor layer, are compared. They rely on different transduction methods, i.e., electrochemistry and surface plasmon resonance (SPR) in optical fibers. In particular, D,L-penicillamine was used as the specific receptor since it is a strong ligand for copper(II). Moreover it is easily immobilized on a gold layer by a self assembling procedure by contacting the gold layer overnight with water/EtOH (80/20) containing D,L-penicillamine, taking advantage of the spontaneous interaction of thiols with gold surfaces. Both the electrochemical and SPR platforms were derivatized in the same way. In the first case a gold disc was used as working electrode, and in the second one a thin gold layer (60 nm thick) was deposited by sputtering over the exposed core of a D-shaped plastic optical fiber (POF), after removing the cladding along half circumference.

Abstract

131. Sensing of Furfural by Molecularly Imprinted Polymers on Plasmonic and Electrochemical Platforms

Maria Pesavento [1,*], Nunzio Cennamo [2], Giancarla Alberti [1], Simone Marchetti [1] and Luigi Zeni [2]

[1] Department of Chemistry, University of Pavia, Pavia, Italy
[2] Department of Engineering, University of Campania Luigi Vanvitelli, Aversa, Italy
* Correspondence: maria.pesavento@unipv.it

The goal of this work is to test the possibility of selective detection of furfural (2-FAL) in aqueous solutions, with a molecularly imprinted polymer (MIP) receptor exploiting two different transduction methods, for food safety applications. In particular, sensors with electrochemical and surface plasmon resonance (SPR) transduction are considered. Two concentration ranges could be investigated by the different sensing approaches since the detectable concentration level depends on the sensitivity of the detection technique employed. The determination of 2-FAL at different concentration levels in the aqueous medium of interest, as for example beverages, is becoming a very crucial task not only for the relevance of furanic compounds in affecting the flavor but also for their possible toxic and carcinogenic effects on the human beings. For these reasons, their determination by a fast, easy and low-cost method is of interest. The sensor methods here proposed appears to be particularly suitable, even since, together, they allow the determination in a wide concentration range to be performed.

Abstract

132. Sensing of Nucleic Bases Based on Molecularly Imprinted Polymers

Jaroslava Bezděková

Department of Chemistry and Biochemistry, Mendel University in Brno, Zemedelska 1, 613 00 Brno, Czech Republic

* Correspondence: bezdekovajar@gmail.com

In this work the simple, sensitive and eco-friendly method of nucleic bases isolation and detection was investigated. This method is based on a technique of non-covalent molecular imprinting, which was used to create synthetic receptors for the nucleic bases. These synthetic receptors allow to isolate imprinted nucleic base from complex samples. As a functional monomer a dopamine was used. The dopamine has a range of advantages as biocompatibility, biodegradability, simple oxidation process and contains several functional groups that can interact with imprinted molecule. The experiments focused to binding affinity and selectivity of prepared polymers were carried out. All experiments with dopamine imprinted polymers were evaluated by using capillary electrophoresis with absorbance detection at wavelength of 260 nm. It was found that the imprinted polymers show higher binding affinity toward chosen nucleic base than non-imprinted polymers that was used as an indicator of nonspecific interaction. Also, the selectivity in comparison with others nucleic bases was more than satisfactory.

Abstract

133. Dynamic Catadioptric Sensory Data Fusion for Visual Localization Inmobile Robotics

David Valiente [1,*], Luis Payá [1], Jose María Sebastián [2,3], Luis Miguel Jiménez [1] and Oscar Reinoso [1]

[1] Miguel Hernández University
[2] Polytechnic University of Madrid
[3] CAR-CSIC-Center for Autonomous Robots
* Correspondence: dvaliente@goumh.umh.es

This approach presents a localization technique within mobile robotics sustained by visual sensory data fusion. A regression inference framework is designed with the aid of informative data models of the system, together with support of probabilistic techniques such as Gaussian Processes. As a result, the visual data acquired with a catadioptric sensor is fused between poses of the robot in order to produce a probability distribution of visual information in the 3D global reference of the robot. In addition, a prediction technique based on filter gain is defined to improve the matching of visual information extracted from the probability distribution. This work reveals an enhanced matching technique for visual information in both, the image reference frame, and the 3D global reference. Real data results are presented to confirm the validity of the approach when working in a mobile robotic application for visual localization. Besides, a comparison against standard visual matching techniques is also presented. The suitability and robustness of the contributions are tested in the presented experiments.

Abstract

134. SERS Analysis of Bacterial Strains: *Escherichia coli* and *Staphylococcus epidermidis*

Niccolò Paccotti [1,*], Alessandro Chiadò [1], Chiara Novara [1], Fabrizio Giorgis [1], Francesco Geobaldo [1], Francesco Boschetto [2,3], Elia Marin [2,3], Satoshi Horiguchi [3,4] and Giuseppe Pezzotti [2,3,5,6]

[1] Department of Applied Science and Technology, Politecnico di Torino, Torino, Italy
[2] Ceramic Physics Laboratory, Kyoto Institute of Technology, Kyoto 606-8585, Japan
[3] Department of Immunology, Kyoto Prefectural University of Medicine, Kyoto 602-0841, Japan
[4] Department of Dental Medicine, Kyoto Prefectural University of Medicine, Kyoto 602-0841, Japan
[5] Department of Orthopedic Surgery, Tokyo Medical University, Tokyo 160-8402, Japan
[6] The Center for Advanced Medical Engineering and Informatics, Osaka University, Osaka 565-0871, Japan
***** Correspondence: niccolo.paccotti@polito.it

Bacteria are prokaryotic microorganism whose pathogenic activity can affect every aspect of daily life. In this context, a powerful tool for their detection is provided by the Surface Enhanced Raman Spectroscopy (SERS), that can reveal the cellular composition of different bacterial strains with high sensitivity and intrinsic specificity. In this study, mesoporous silicon-based SERS substrates decorated with silver nanoparticles were used to investigate the vibrational pattern of *S. epidermidis* and *E. coli*, representative Gram-positive and Gram-negative bacteria, to provide a reproducible method to discriminate between distinct bacterial strains. At first, each spectrum was completely characterized in order to evaluate the contribution of each vibrational mode. The SERS spectra showed species-related features, arising from the different composition of the cell wall as well as their distinctive biofilm matrix and metabolic pathways. Furthermore, a life cycle analysis was carried out monitoring the evolution of the main SERS bands over time, analyzing the bacteria population after 12, 24 and 48 h of culture The results pointed out an increase of the intensity of the bands after 24 h, while a successive decrease at 48 h was observed, in agreement with the bacterial growth profile.

Abstract

135. Spectral Tuning of Long Period Fiber Gratings Fabricated by Femtosecond Laser Micromachining through Thermal Annealing

Duarte Viveiros [1,2,*], José M. M. M. de Almeida [1,3], Luís Coelho [1,2,*], Helena Vasconcelos [1,3], Vítor A. Amorim [1,2], João M. Maia [1,2], Pedro A. S. Jorge [1,2,*] and P. V. S. Marques [1,2]

[1] Center for Applied Photonics, INESC TEC - Technology and Science
[2] Department of Physics and Astronomy, Faculty of Science at University of Porto
[3] Department of Physics, University of Trás-os-Montes e Alto Douro
* Correspondence: carlos.d.viveiros@inescporto.pt

Long period fiber gratings (LPFGs) are being studied for a long time and there are different fabrication mechanisms. In this work, a femtosecond laser with ~250 fs of pulse duration was used to develop LPFGs in common single mode fibers. The optimum conditions to write LPFGs were attained with 65 mW on-target power and 50 μm/s scan speed. For a modulation period of 372.5 μm, the light is well coupled into the cladding mode $LP_{1,6}$ which is translated in a transmission attenuation band at 1500 nm. Exposing the entire LPFG to temperature annealing from 25 to 950 °C modifications in the refractive index modulation at 25 °C are observed through a blue-shift in the LPFG attenuation band and above 850 °C the mode $LP_{1,7}$ appear at 1600 nm. The annealing process can be used to tune the spectral position of the attenuation band and while turning it stable to the final temperature. The wavelength sensitivity to external RI from 1.300 to 1.452 was estimated for both modes before and after annealing. Greater sensitivity was found for the higher-order mode in the entire range reaching 2400 nm/RIU around 1.440. Refractive index resolutions of 0.0039 RIU, 0.0039 RIU and 0.0025 RIU were achieved for the cladding mode $LP_{1,6}$ (before and after annealing) and $LP_{1,7}$, respectively.

Abstract

136. Suitability of General Purpose PPG-Based Wearable Devices for HRV Analysis

Jaime Yagüe-Mayans [1,2], Santiago Jiménez Serrano [3], José Millet [3], Francisco Castells [3] and Raquel Cervigon Abad [4,*]

[1] Escuela Politécnica Cuenca, Universidad de Castilla la Mancha, Spain
[2] Universidad Internacional de Valencia, Spain
[3] Instituto ITACA, Universitat Politècnica de València, Spain
[4] Universidad de Castilla-La Mancha
* Correspondence: raquel.cervigon@uclm.es

Wereable devices incorporating photoplethysmographic sensors can be useful for HRV analysis both in clinical and healthcare applications. However, such devices do not always provide the raw PPG signal and usually apply averaging techniques to detected RR series in order to minimize variability in heart rate measurements due to detection errors. In this study PPG signals obtained during orthostatic test (N=5) were used in order to assess the effects of averaging techniques on classical HRV parameters (6 parameters in the time domain and 7 parameters in the frequency domain) and their capability for distinguishing between tilt situations during the orthostatic test. Activations were detected on PPG and simultaneous ECG signals, used as gold standard, and RR series were calculated in two tilt situations. Then averaging windows of different sizes (2.5/5/10 s) were applied to the RR series derived from PPG records. Finally, a separability index Q was calculated in order to evaluate the performance of each parameter separately for tilt position classification. Results obtained were in accordance with those previously presented in the literature when no averaging window was applied. Time domain parameters were more affected by averaging techniques than frequency domain parameters although all of them retained their classification capability when shorter averaging windows were used. Definitely, long averaging windows should be avoided when analyzing HRV but results may be slightly enhanced when short averaging windows are used.

Abstract

137. Ultra-High Dose Monitoring with Innovative Lab-on-Fiber Radiation Dosimeter

Giuseppe Quero [1,*], Patrizio Vaiano [1], Francesco Fienga [2,3], Martino Giaquinto [1], Valentina Di Meo [4], Georgi Gorine [3,5], Pierluigi Casolaro [6], Luigi Campajola [6], Giovanni Breglio [7], Alessio Crescitelli [4], Emanuela Esposito [4], Armando Ricciardi [1], Antonello Cutolo [1], Federico Ravotti [3], Salvatore Buontempo [4], Marco Consales [1] and Andrea Cusano [1]

[1] Optoelectronic Division—Eng. Department, University of Sannio, 82100 Benevento, Italy
[2] Istituto Nazionale di Fisica Nucleare (INFN) - Sezione di Napoli, I-80126 Napoli, Italy
[3] European Organization for Nuclear Research (CERN), 1211 Genève, Switzerland
[4] Istituto per la Microelettronica e Microsistemi, Consiglio Nazionale delle Ricerche, I-80131 Napoli, Italy
[5] Ecole Polytechnique Federale de Lausanne (EPFL), Lousanne, Vaud, Switzerland
[6] University of Napoli Federico II, Department of Physics, I-80126 Napoli, Italy
[7] University of Napoli Federico II, Department of Electronical Engineering, I-80125 Napoli, Italy
***** Correspondence: giuseppe.quero@unisannio.it

We report on a novel Lab on Fiber (LOF) dosimeter for ionizing radiation monitoring at ultra-high doses. The new dosimeter consists in a metallo-dielectric resonator at sub-wavelength scale supporting localized surface plasmon resonances realized on the optical fiber (OF) tip. The resonating structure involves two gold gratings separated by a templated dielectric layer of poly(methyl methacrylate) (PMMA). Two LOF prototypes have been manufactured and exposed, at the IRRAD Proton Facility at CERN in Geneva, to 23 GeV protons for a total fluence of 0.67×10^{16} protons/cm^2, corresponding to an absorbed dose of 1.8 MGy. Experimental data demonstrate the "radiation resistance" feature of the LOF devices and a clear dependence of the reflected spectrum on the total dose, expressed by a cumulative blue-shift of ~1.4 nm of the resonance combined with a slight increase of 0.16 dBm in the reflected spectrum. According to the numerical analysis and the literature, the main phenomenon induced by exposure to proton beam and able to explain the measured spectral behavior is the reduction of the PMMA thickness. Preliminary results demonstrated the potentiality of the proposed platform as dosimeter at MGy dose levels for high energy physics experiments.

Abstract

138. Wireless Air Quality Sensor Systems for Pollution Mapping

Christophe Delebarre * and Samuel Dupont

Université de Valenciennes et du Hainaut Cambrésis, IEMN-DOAE UMR CNRS8520

* Correspondence: christophe.delebarre@univ-valenciennes.fr

Air quality measurement for pollution mapping in urban areas is a key point for humanhealth protection. Because car exhausts gas may provide, in the case of high concentration, manybreathing diseases, it becomes important to quantify the concentration level of fine particles andgases. Furthermore, if each urban vehicle is able to measure the different levels of pollutants andsend it to a server, it becomes easy to perform a mapping of the different pollutants. This paperpresents and compares two methods of gas detection for indoor and outdoor purposes: MetalOxide sensors and Non Dispersive Infrared ones. Both of them were implemented in a differentprinted circuit board in order to obtain different aspects of the air pollution. Some experimentswere achieved to compare the results from both solutions: the first one with a brief perturbation,the second one in a closed room nearly filled with students and the last one next to an exhaust pipeor directly while driving on the road.

Abstract

139. Wireless Electronic Sensing System for Real-Time Monitoring of Pneumatic Tires

Michele Riccio [1,*], Salvatore Strano [2], Mario Terzo [2], Vincenzo Romano Marrazzo [1], Luca Maresca [1], Andrea Irace [1] and Giovanni Breglio [1]

[1] Department of Electrical Engineering and Information Technologies, University of Naples "Federico II"
[2] Department of Industrial Engineering, University of Naples "Federico II"
* Correspondence: michele.riccio@unina.it

Electronic vehicle control units are usually based on on-board sensors. Consequently, many of all the important parameters for the vehicle dynamics are estimated indirectly. An attractive way for improving the performances of vehicle controllers is represented by the possibility to adopt measurements on the tire. Indeed, tires are the vehicle part in contact with the road surface, where all the road disturbances act and where the forces are generated. The aim of this paper is the presentation of a functional, simple and economical intelligent tire prototype. In particular, a flex sensor and a PVDF sensor, bonded on the inner liner of a pneumatic tire, with a wireless communication system, have been adopted to obtain some tire working condition features. The prototype described in this paper is a first attempt and preliminary in-door and out-door experimental results are illustrated. The output signal from both sensors is converted to a digital signal by means of a microcontroller (MCU) based circuit board (STM32F303K8T6). The used MCU is equipped with two fast 12-bit ADCs with 5 Msps maximum sampling rate, while in our application the sampling frequency is chosen to be f_S = 12 kHz. The developed system is designed to send data packets in real-time over a wireless channel (2.4 GHz) to a Control Unit (CU) by means of a NRF24L01+ transceiver. The CU is itself connected to a personal computer for data analysis.

Abstract

140. ZnO-MWCNTs Hybrid Layer for UV Light Detection

Stefano Boscarino

CNR-IMM, Ottava Strada n.5, I-95121 Catania, Italy; stefano.boscarino@imm.cnr.it

Zinc oxide (ZnO) nanoparticles decorated multi-walled carbon nanotubes (CNTs) were prepared by a simple liquid phase process and then deposited as nanocomposite layer between two electrodes. Optical, structural and electrical properties at different ZnO:CNTs weight ratios were investigated. The combination between CNTs and metal oxide provides the electrical transduction element and the sensitive material, respectively. In particular, the UV detection properties of the nanocomposites were studied by recording the resistance changes of the devices under UV irradiation, at very low operation voltage. As the device is exposed to the UV light, a sharp resistance increase takes place and then a drop is observed as the irradiation is stopped. The detection mechanisms are explained by adsorption and desorption phenomena taking place on the ZnO surface and charge transfer, under UV irradiation. The hybrid material shows good sensitivity and fast response to UV irradiation, and, in combination with its intrinsic electrical transduction property, thanks to carbon nanotubes, reveals itself to be very promising for UV detectors applications. Devices based on such hybrid material allow to overcome some energy consumption issues, due to high operating temperature and voltage. Their production methodology and operation conditions are also compatible with low cost plastic substrates.

Abstract

141. A Green Slab Waveguide for Plasmonic Sensors Based on Bacterial Cellulose

Nunzio Cennamo [1], Carlo Trigona [2,*], Salvatore Graziani [2], Luigi Zeni [1], Francesco Arcadio [1], Giovanna Di Pasquale [3] and Antonino Pollicino [4]

[1] Department of Engineering, University of Campania L. Vanvitelli, Aversa, Italy; nunzio.cennamo@unicampania.it (N.C.); luigi.zeni@unicampania.it (L.Z.); francesco.arcadio@unicampania.it (F.A.)
[2] D.I.E.E.I. University of Catania, Viale Andrea Doria 6, 95125, Catania, Italy; salvatore.graziani@dieei.unict.it
[3] D.S.C., Dipartimento di Scienze Chimiche University of Catania, Viale Andrea Doria 6, 95125, Catania, Italy
[4] D.I.C.A.R., University of Catania, Viale Andrea Doria 6, 95125, Catania, Italy
* Correspondence: carlo.trigona@dieei.unict.it

Abstract: We use as optical waveguide a green composite, based on bacterial cellulose (BC). More specifically, we have sputtered a thin gold film on this innovative slab waveguide for obtaining a Localized Surface Plasmon Resonance (LSPR) sensor. Experimental results confirm the possibility of using the BC based composite as an environmental friendly optical sensor platform with plasmonic capabilities, which could be exploited for realizing disposable biosensors. The new optical sensor has been used by combining it with optical fibers. The fibers connect the green disposable optical sensor with a light source and with a spectrometer. The device has been tested by measuring the refractive index of different water-glycerin solutions.

Keywords: Optical sensors; sustainable development; localized surface plasmon resonance; bacterial cellulose; refractive index measurement.

Abstract

142. OFDR Sensing Technology Based Distributed Monitoring and Stability Analysis of Geogrid-Reinforced-Slope

Yijie Sun [1], Hongdou Du [1], Suqian Cao [1], Hongzhong Xu [1,*], Zheng Quan [1] and Bin Shi [2]

[1] Nanjing Tech University
[2] Nanjing University
* Correspondence: hzhxu@163.com

The smart geogrids installed with distributed fiber sensors can be used to both reinforce and monitor the stability of geogrid-reinforced slopes. In this paper, a geogrid-reinforced sand slope model was conducted in the laboratory. The fully distributed optical frequency domain reflectometry (OFDR) sensing technology was employed to measure the strain distribution of the geogrid embedded inside the model slope. Afterward，the surcharge loading was applied on the slope crest and the distributed fiber optic sensing data were collected under different stages. The monitoring results show that the fiber optical sensors can capture the progressive deformation of the geogrid-reinforced slope. Based on the model test, the performance of the reinforced soil slope is simulated by finite element software Plaxis2D as well. The strength reduction method was used to analyze the stability of the slope. An empirical relationship between the geogrid strain and the factor of safety was set up. The results indicate that the measured strain and calculated results agree very well. The strain of geogrid monitored by distribute optical fiber sensor can be used to evaluate the stability of geogrid-reinforced sand slopes.

Abstract

143. Development of a Real Time Image Analysis Sensing Methodology for pH Measurement in Pressurized Systems and Application for CO_2-H_2O Systems

Alline Viana de Oliveira [1], Vinicius Kartnaller [1,*], Ronald Wbeimar Pacheco Ortiz [1], Monica de Oliveira Penna [2], Francisca Ferreira do Rosário [2], Vinicius Ottonio O. Gonçalves [1] and João Cajaiba [1]

[1] Universidade Federal do Rio de Janeiro, Instituto de Química, Núcleo de Desenvolvimento de Processos e Análises Químicas em Tempo Real - NQTR, Rua Hélio de Almeida 40, Cidade Universitária, CEP 21941-614 Rio de Janeiro, RJ, Brazil

[2] Centro de Pesquisas e Desenvolvimento Leopoldo Américo Miguez de Mello, PETROBRAS, Cidade Universitária, Rio de Janeiro 21040-000, Brazil

* Correspondence: vkartnaller@yahoo.com.br

The pH is an important parameter that should be monitored and controlled, especially in industrial processes where CO_2 plays an important role. However, the use of sensors and new materials that support high pressure is still an unviable possibility due to high costs. The application of different techniques as a way to measure the pH in high pressure have also been proposed, but still poses as a problem, due to lack of reproducibility among experiments. Hence, this work presents a low-cost, real time, reproducible technique using hsv image analysis to measure the pH in CO_2-H_2O pressurized systems. A calibration curve was constructed with nine buffer solutions (pH = 2–10) using a mixture of pH indicators whose hue varies at each pH unit. The hsv color system was determined in pressures up to 6.0 MPa and correlated to the pH value. Then, the pH of pure water pressurized between 0.1 to 5.0 MPa with CO_2 at 298 K, was determined by means of the pH-hsv fit and the obtained results were similar to the theoretical pH values calculated from the solubility of CO_2 in water at the experimental conditions.


MDPI