NANOMATERIALS-MODIFIED SPEs: A POWERFUL PLATFORM FOR SENSOR AND BIOSENSOR SET-UP.

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INTRODUCTION

Screen-printed electrodes (SPEs) are recognized as successful electroanalytical sensor platforms due to their low background current, wide potential window, cost-effectiveness, and easiness of surface modification. This last property allows the modification of the screen-printed electrodes (SPEs) with several nanomaterials such as carbon nanotubes, graphene, nanoparticles, graphene nanoplates (GNPs)[2], etc[3,4]. The main advantages in the application of nanomaterials-based sensors are the higher sensitivity, stability, and improved repeatability[1]. Indeed, the main goal in the analytical field is always to develop unconventional methods and sensitive, inexpensive and user-friendly platforms. In this work, nanoengineered electrodes have been characterized by scanning electron microscopy (SEM), Raman spectroscopy , cyclic voltammetry and square wave voltammetry (SWV).

These platforms have been all applied in the development of an enzymatic biosensor able to monitor and quantify uric acid in the micromolar (μM) range. In particular, the limit of detection (LOD, going from 48 μM to 12 μM), linear range (from 0.05-2 mM to 0.02-5 mM) and Km (Michaelis-Menten Constant, from 0.43 to 1.31 mM) undergo remarkable ameliorations for bare and -CO_2H MWNT based biosensors, respectively.

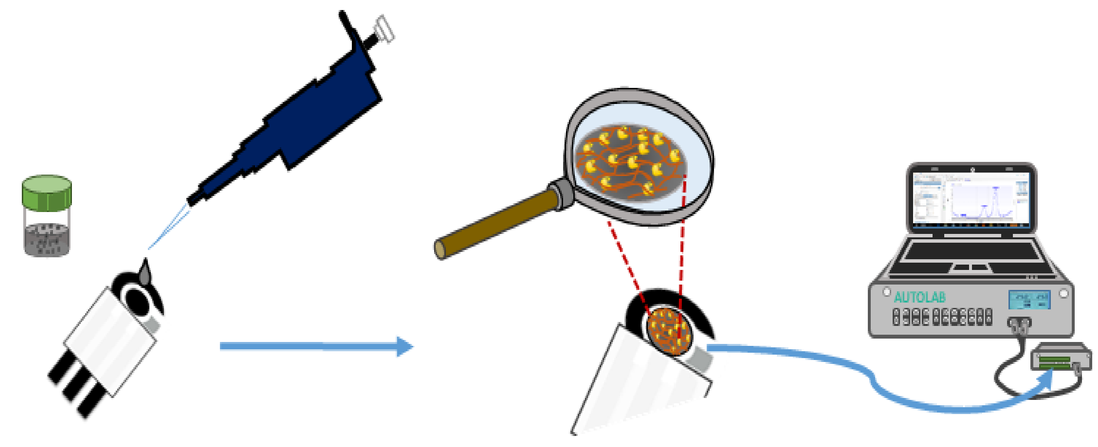
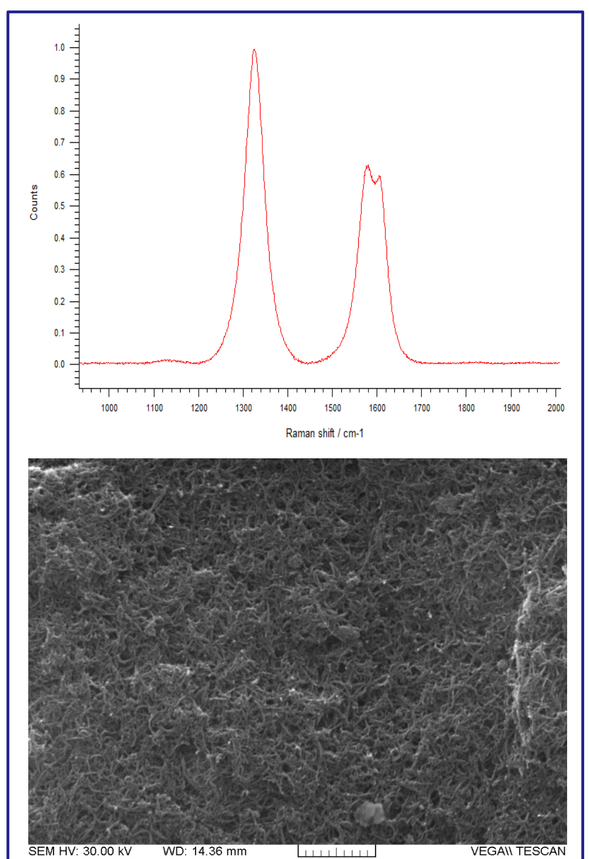


Figure1 Schematic representation of nanomaterial-modified SPE: a) by drop casting and then used to set up a biosensor, b) enzyme immobilization. Electrochemical measurements can be performed using portable instrumentation (c).

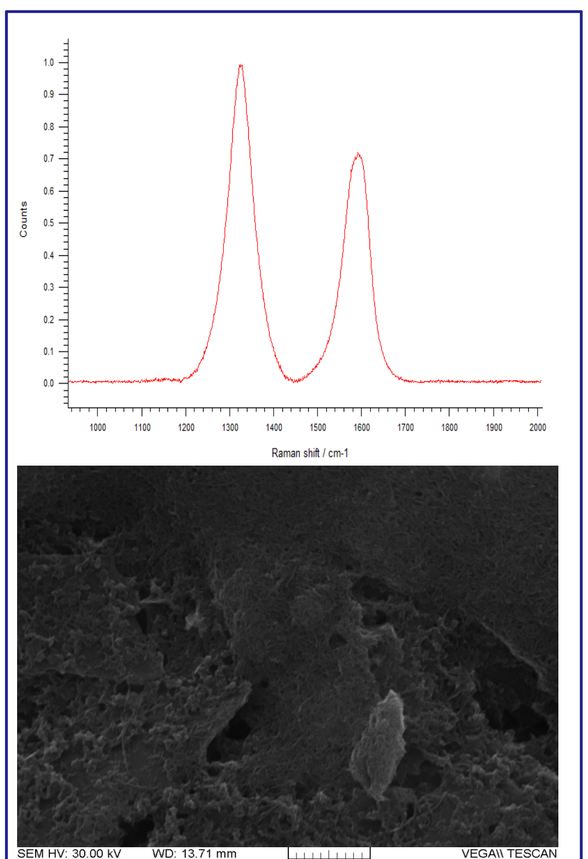
RESULTS AND DISCUSSION

Morphological Characterization of Nanomodified-platform: Raman and SEM analysis

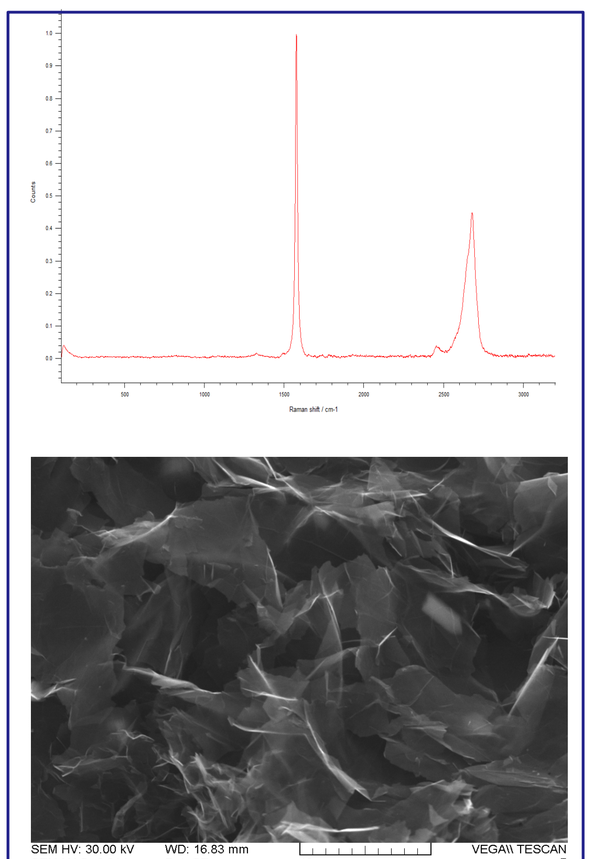
Bare MWNT



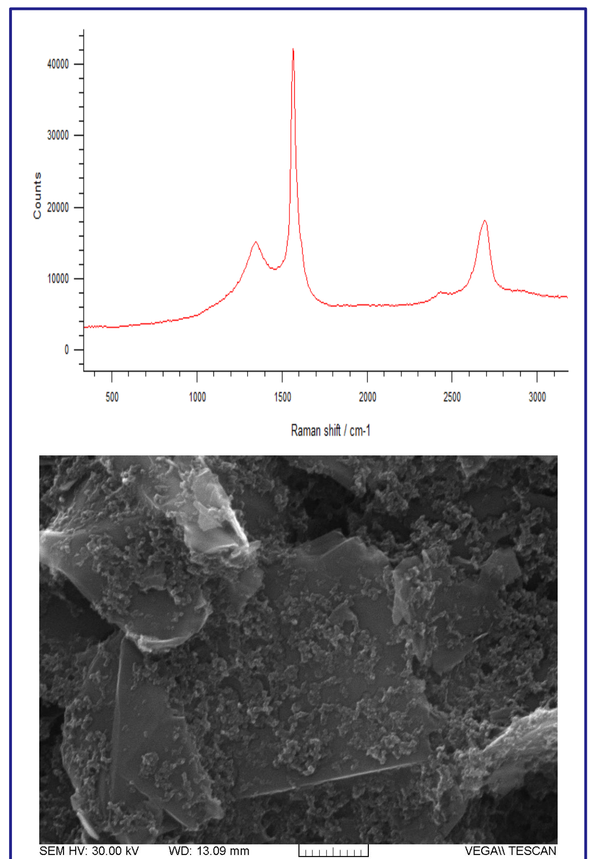
-CO_2H MWNT



-Graphene Nanoplatelets



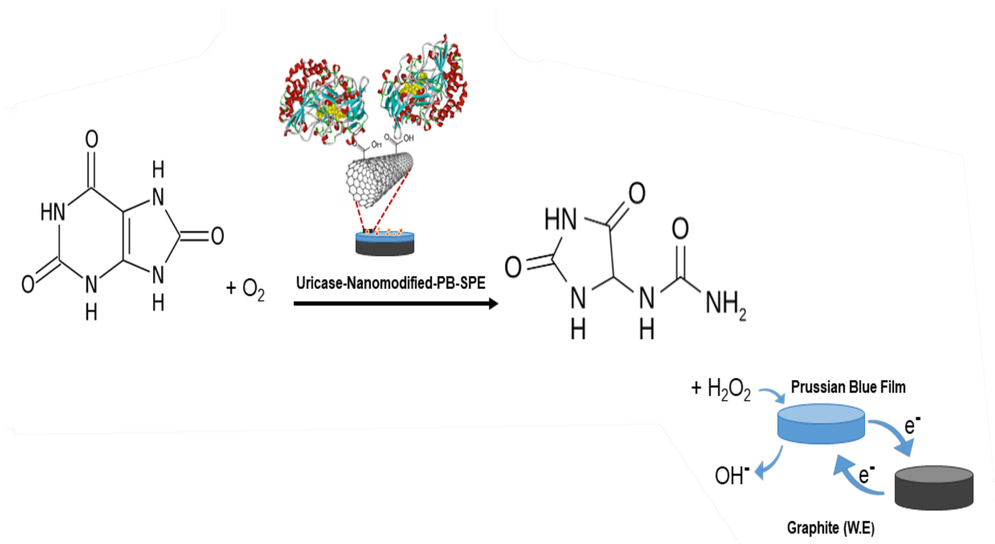
-Bare Electrode



Amperometric Characterization and Biosensing of Uric Acid

	Bare Electrode	Bare MWNT	-CO_2H MWNT	Bare GNP
$Fe(CN)_6^{4-/3-}$				
|Ipa| / |Ipc|	1.7	1.2	1.2	0.91
k^0 [cm/s]	/	$3.3 \cdot 10^{-3}$	$1.7 \cdot 10^{-3}$	$2.8 \cdot 10^{-3}$
ΔE [mV]	380	77	92	80
LOD [μM]	34.8	2.2	1.2	3.4
RSD% |Iap|	11	6	3	6
RSD% |Icp|	10	5	3	5
% Increase $\|I_{pa}\|$	/	177	460	276
% Increase $\|I_{pc}\|$	/	274	668	312

	Bare Electrode	Bare MWNT	-CO_2H MWNT	Bare GNP
LOD [μM]	48	40	12	24
Linear Range [mM]	0.05-2	0.04-3	0.02-5	0.02-3
Km [mM]	0.43	0.3	1.31	0.5



CONCLUSIONS

Carbon-based modifiers have been spectroscopically, morphologically, and electrochemically characterized and therefore applied to modification of SPEs. All the examined analytical parameters confirm the suitability of bare and functionalized carbon nanomaterials in the electrodic surface area modification, giving rise to a significant improvement in the electrochemical properties of the platforms. These devices, employed in the realization of the uric acid biosensor, allow to detect and quantify lower concentration of analyte (with respect to biosensor based on bare SPE) making the nanoengineered platforms more sensitive and wide-range applicable.

1. X. Wang, et al., *ChemElectroChem, 2014, 1(4), 808–816.* **2)** M. Apetrei et al., Romanian Biotechnological Letters, 2014, 19, 9801-9809. **3**. A.T. Biegunski et al., Electrochim. Acta**,** 2014, 56, 3700-3706. **3**. X. Liu et al., Biosens. Bioelectron., 2014, 51, 76-81. **5**. S. Lupu et al.,, Sensors, 2014, 13, 6759-6774. **6**. B. Kurganov et al., Anal. Chim. Acta, 2001, 427, 11-19.