IOCN 2020

2nd International Online-Conference on Nanomaterials

15–30 NOVEMBER 2020 | ONLINE

# Microwave-assisted hydrothermal synthesis of $Zn_2SnO_4$ nanostructures for photocatalytic dye degradation

nanomaterials MDPI

**Ana Rovisco***, Rita Branquinho, Elvira Fortunato, Rodrigo Martins and Pedro Barquinha*

CENIMAT/i3N, Department of Materials Science, NOVA School of Science and Technology (FCT-NOVA) and CEMOP/UNINOVA, NOVA University Lisbon, Campus de Caparica, Portugal

*a.rovisco@campus.fct.unl.pt, pmcb@fct.unl.pt

# Zinc-Tin Oxide (ZTO)

A. Rovisco et al., ACS Appl. Nano Mater. 2018, 1, 3986−3997
A. Rovisco et al., Nanomaterials 2019, 9, 1002

- Eco-friendly material
- Recyclable
- Multifunctional
- Low-cost material and fabrication

Two crystalline phases:

**$Zn_2SnO_4$**

- ❑ High thermal stability
- ❑ High mobility (112 $cm^2V^{-1}s^{-1}$)

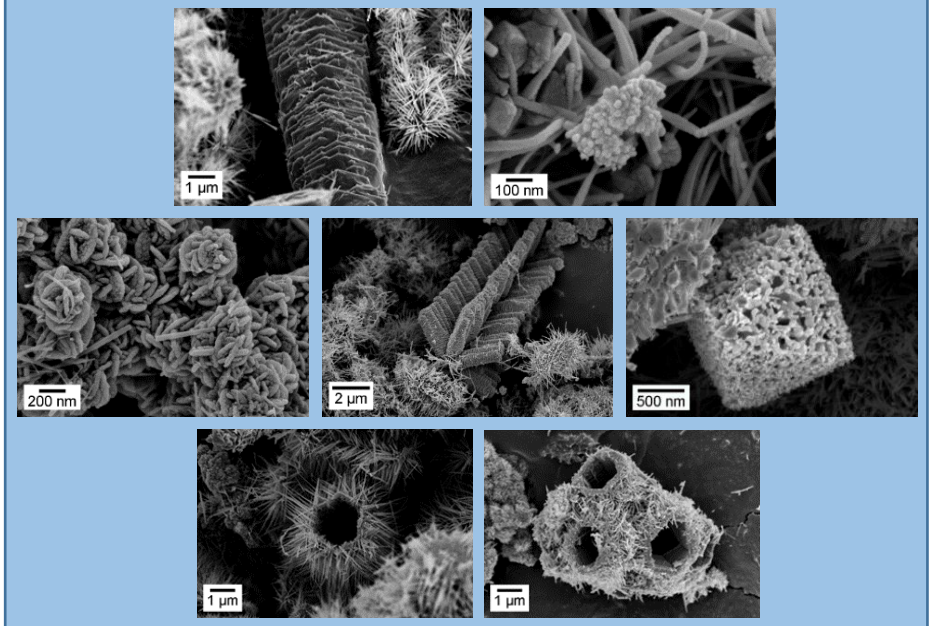
J. Am. Ceram. Soc.,2015, 98, 4044–4049

**$ZnSnO_3$**

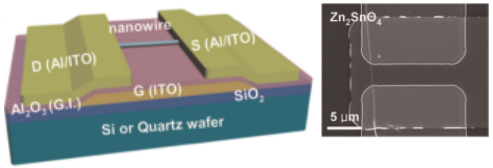
- ❑ Metastable
- ❑ Piezo and ferroelectric properties

J. Mater. Chem. A, 2017, 5, 20534

## Different types of nanostructures



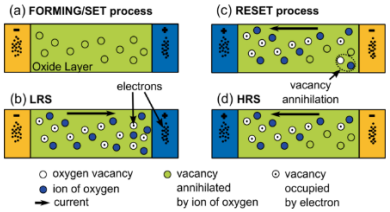
# Multifunctional material ZTO




ACS Nano, 2012, 6, 4912–4920

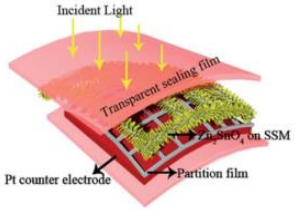
Field Effect Transistors

Resistive Switching Memories




Alexander Makarov, Dissertation, 2014

Solar Cells

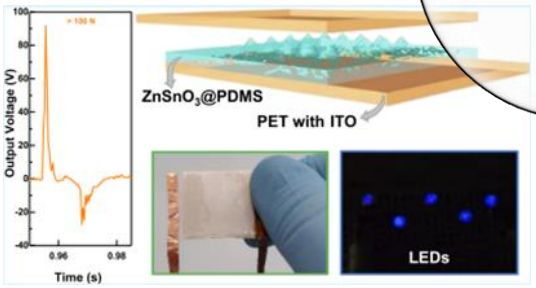



Nanoscale, 2012, 4, 3490–3494

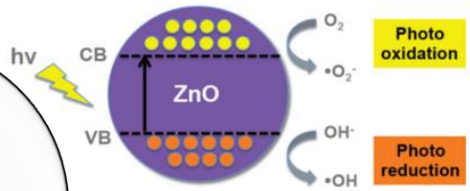
Proc. IEEE 2014, 102, 1723–1746

Energy Harvesting

ACS Appl. Mater. Interfaces 2020, 12, 18421−18430

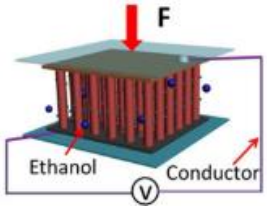



Catalysis




J. Mater. Sci. 2015, 50, 5777–5787

Sensors




Nanotechnology 2014, 25, 115502

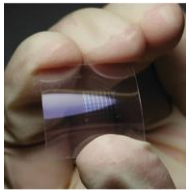
# Experimental Details



❖ *One-step hydrothermal process*: microwave system

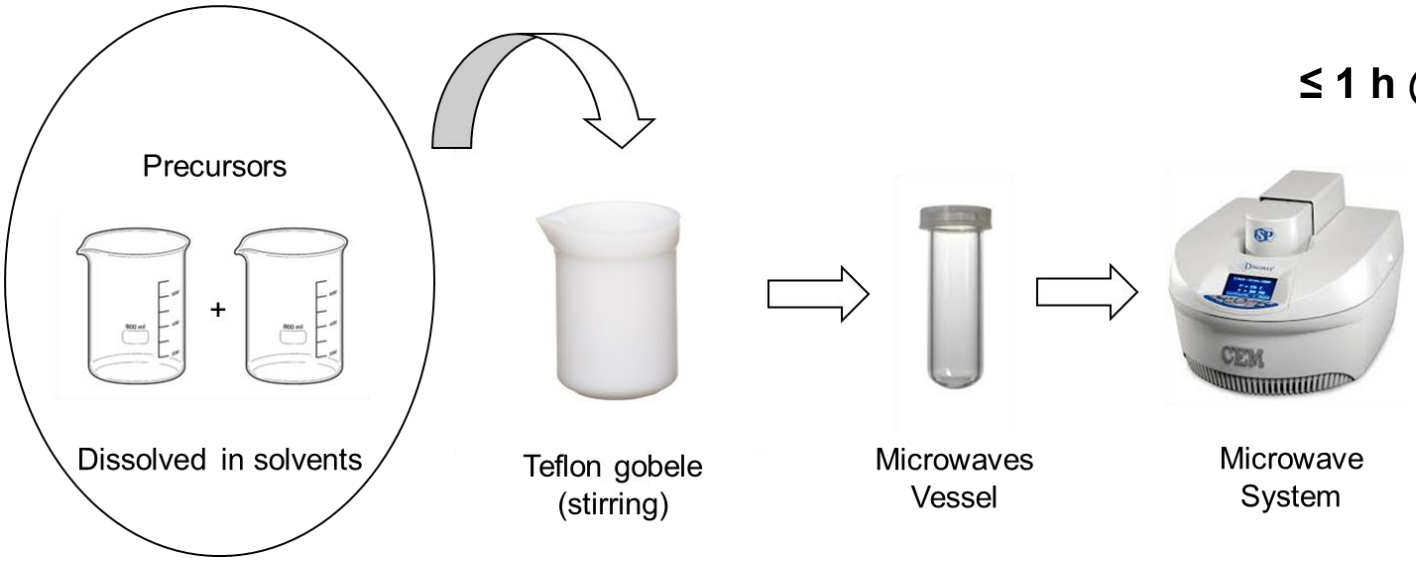
- Low cost
- Low fabrication temperature (< 200 °C)
- Easy fabrication
- Seed-layer free

*Low-cost transparent / flexible substrates*



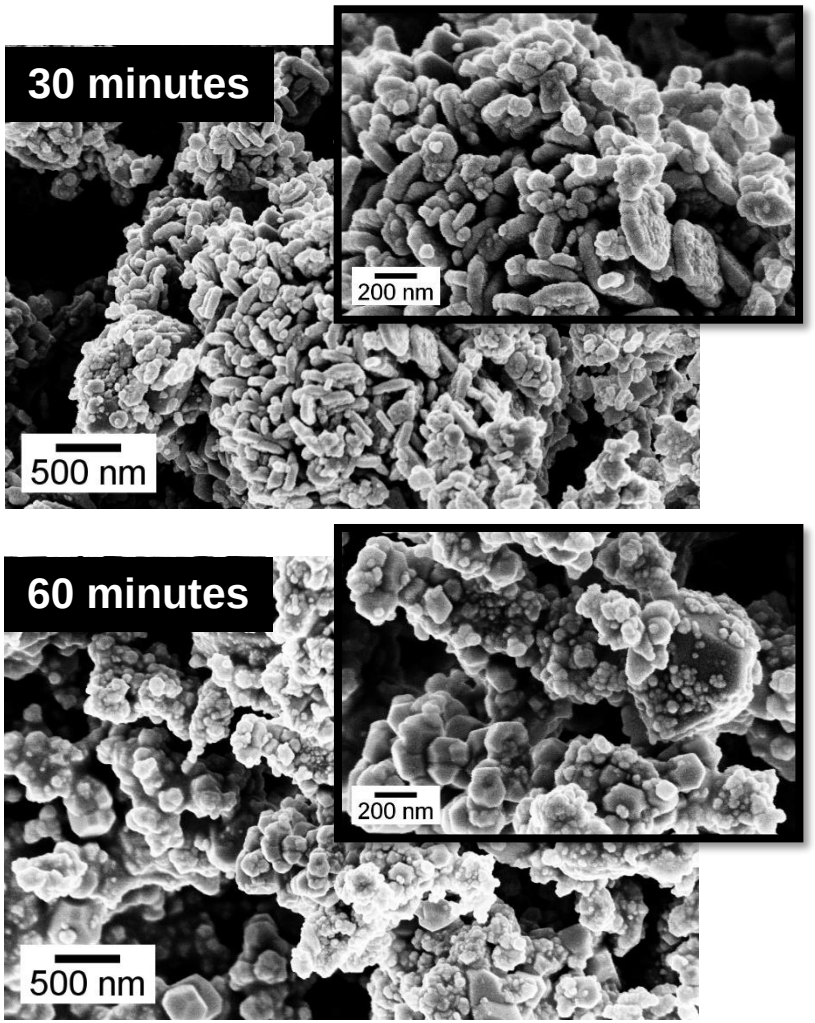
- Glass
- Plastic
- Paper

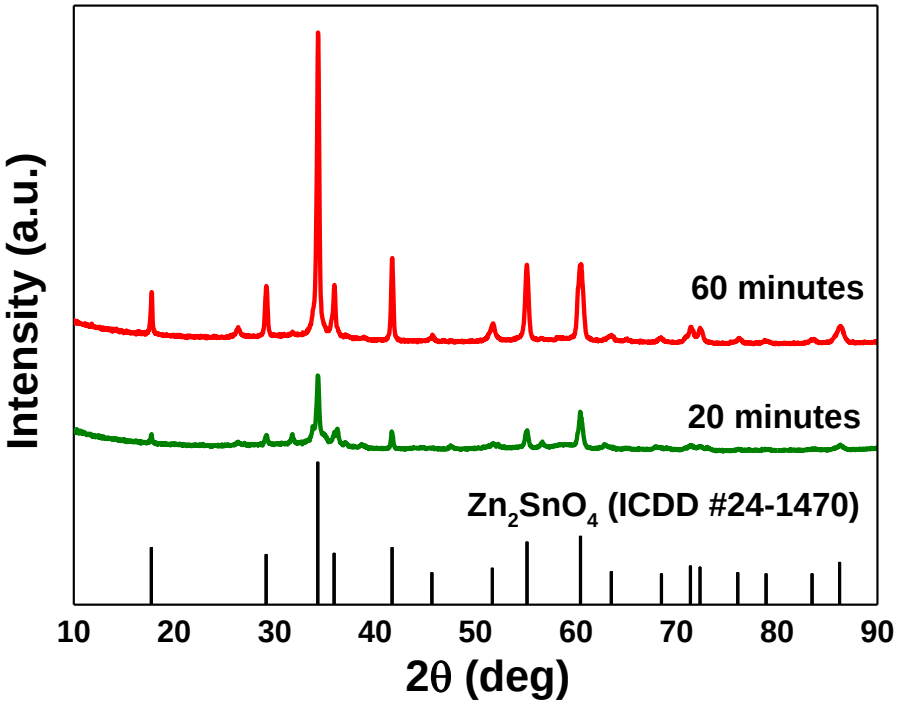
***Synthesis schematic:***




**≤ 1 h @ 200 °C**

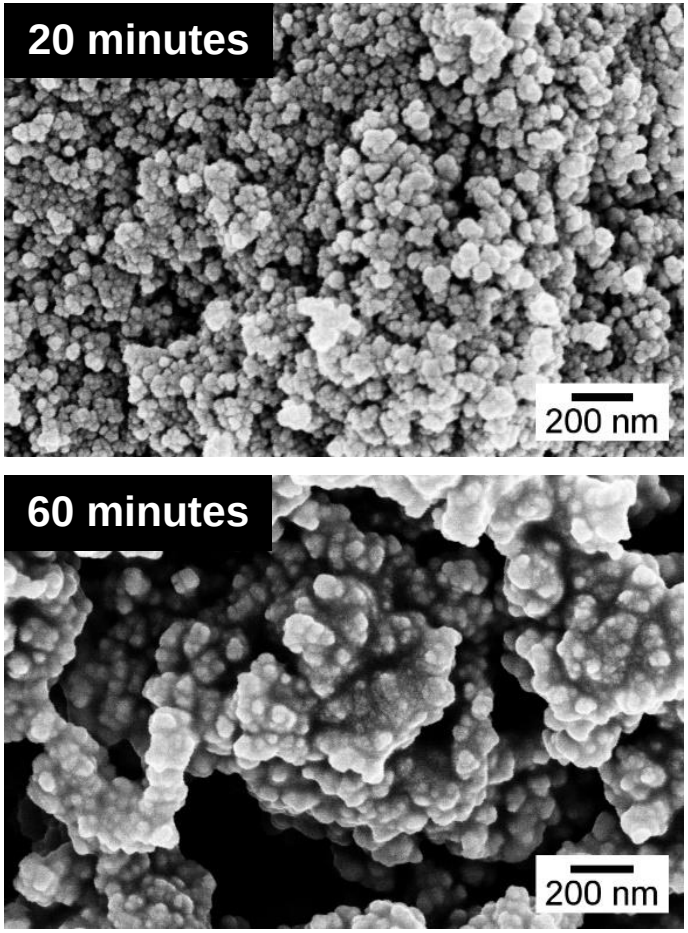
# Microwave-assisted synthesis of $Zn_2SnO_4$ Octahedrons and Nanoplates

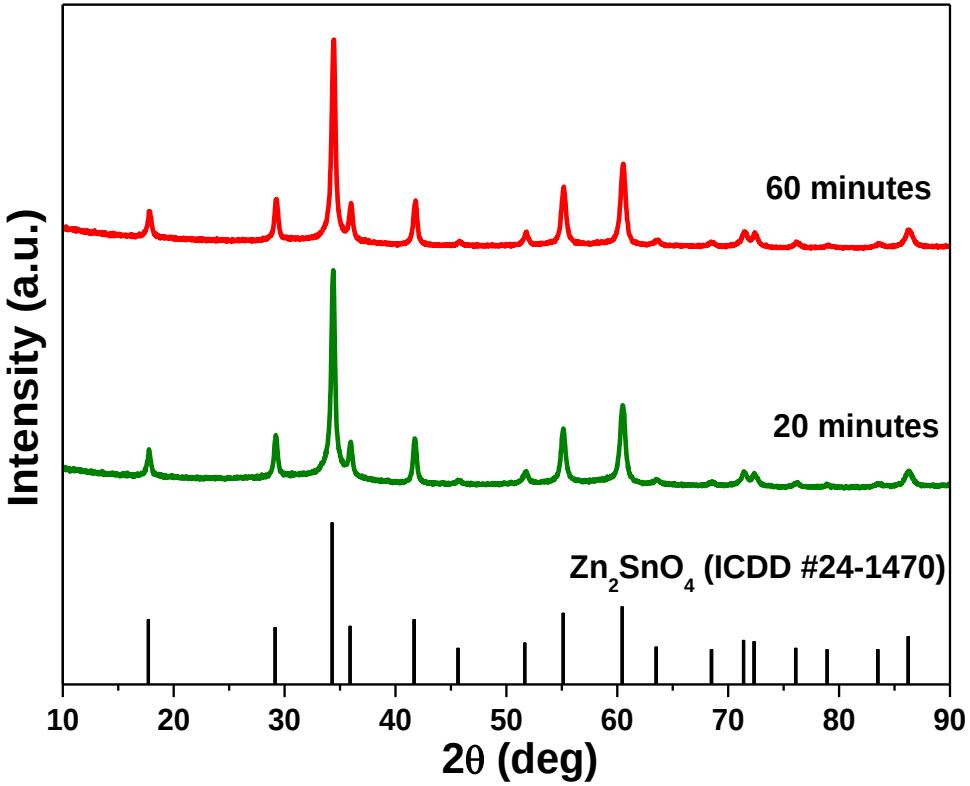



A. Rovisco, Solution-based Zinc Tin Oxide nanostrcutres: from synthesis to applications, PhD thesis, FCT-NOVA 2019

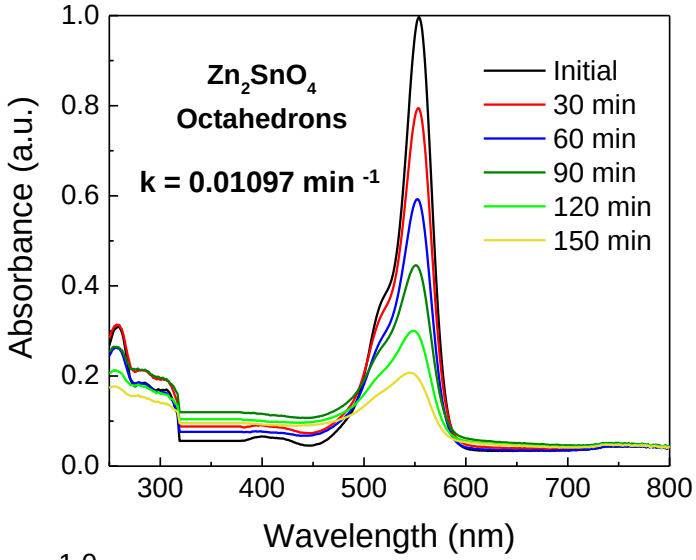
# Microwave-assisted synthesis of $Zn_2SnO_4$ Nanoparticles

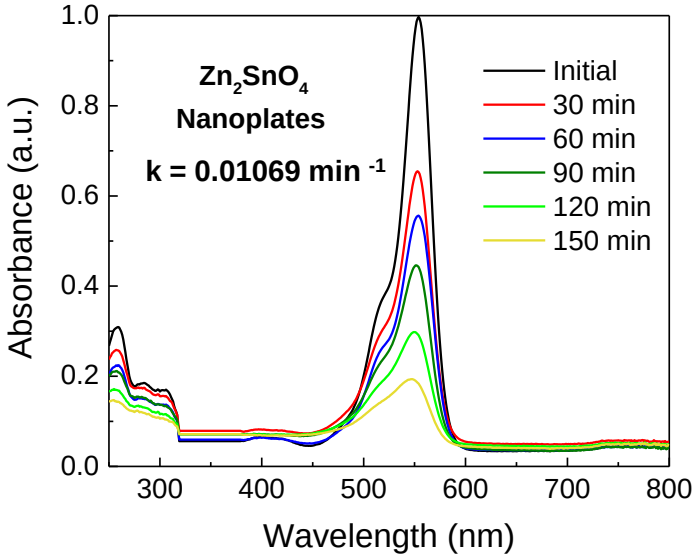


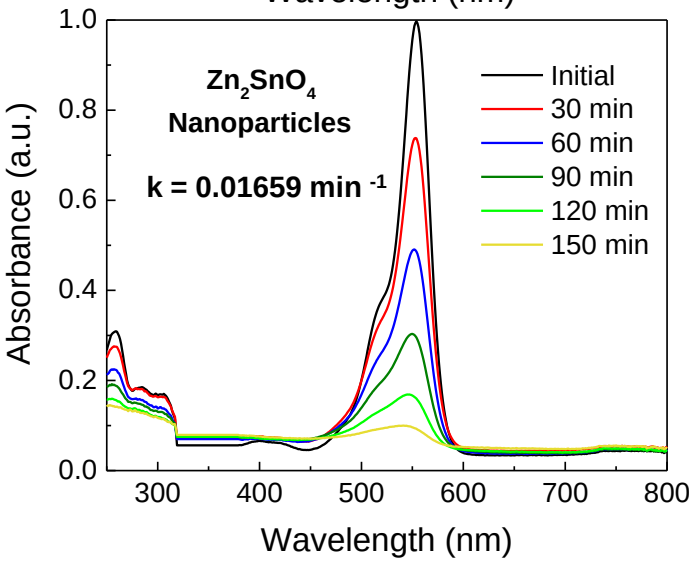



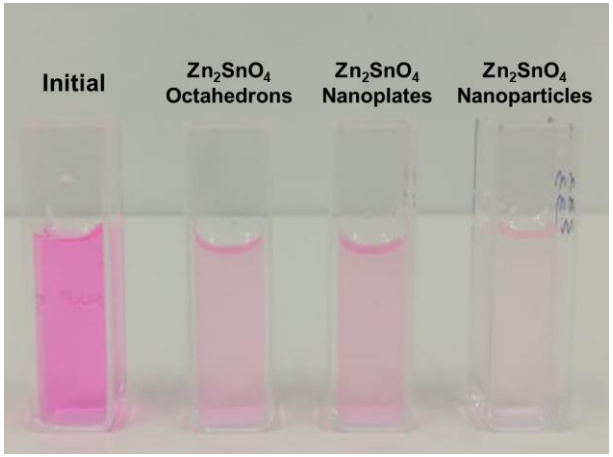

*A. Rovisco, Solution-based Zinc Tin Oxide nanostrcutres: from synthesis to applications, PhD thesis, FCT-NOVA 2019*

# Photocatalytic Activity of ZTO nanostructures under UV light



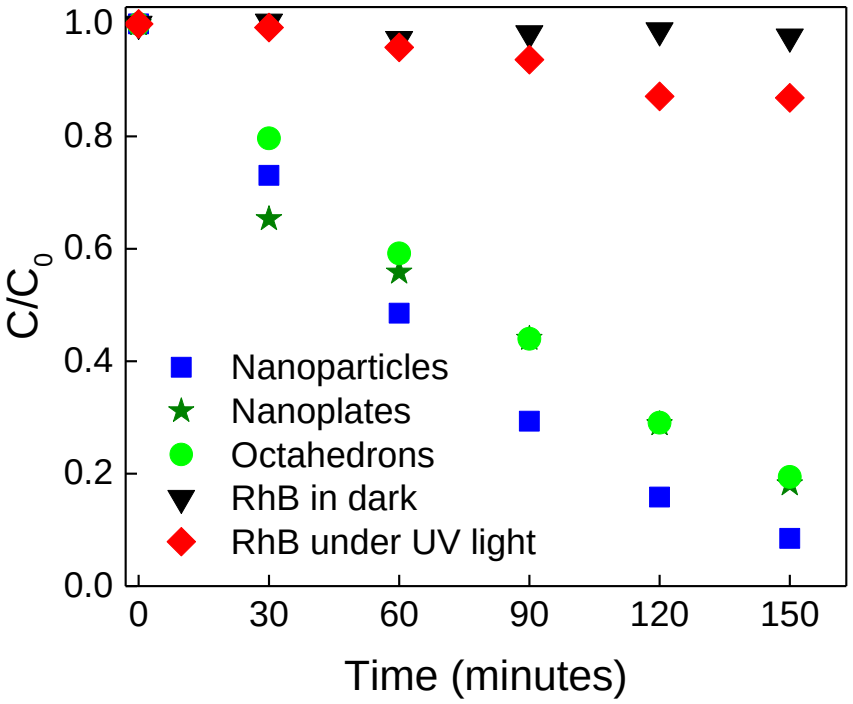



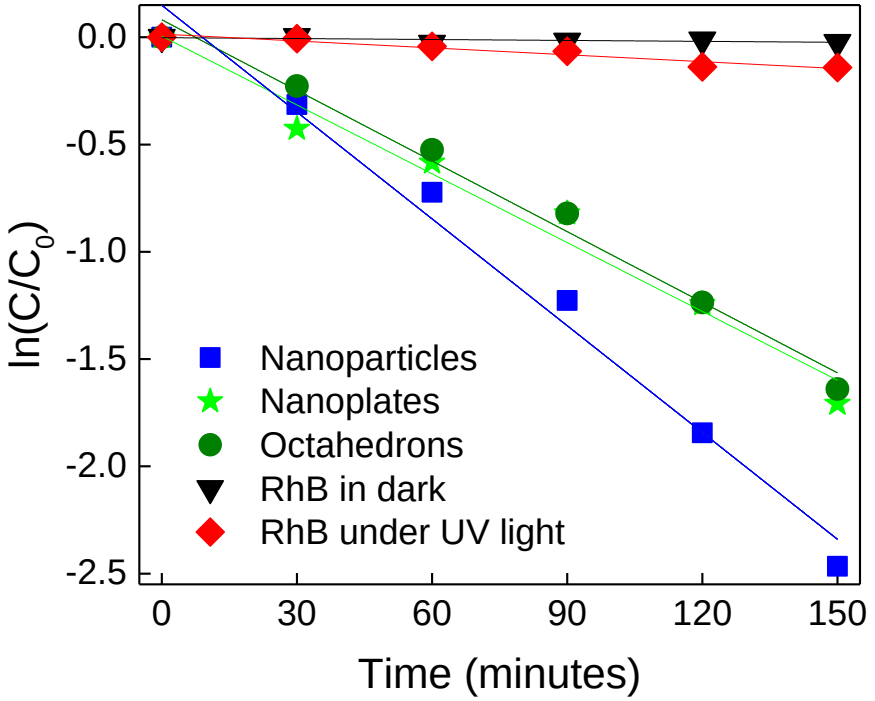




→ 40 mg of ZTO Nanostructures + 50 ml of RhB solution

→ 150 min @ UV-light

# Photocatalytic Activity of ZTO nanostructures under UV light




*Degradation Rates*

Octahedrons: 0.01069 $min^{-1}$ ; Nanoplates: 0.01097 $min^{-1}$ ; Nanoparticles: 0.01659 $min^{-1}$

# Final remarks

**Seed-layer free microwave-assisted hydrothermal synthesis at low temperature (200 °C) for:**

- $Zn_2SnO_4$ Octahedrons
- $Zn_2SnO_4$ Nanoplates
- $Zn_2SnO_4$ Nanoparticles

**Reduction of > 20 hours of syntheses duration**

**Degradation of RhB under UV light in the presence of ZTO nanostructures**

- Best performance achieved for $Zn_2SnO_4$ Nanoparticles

# Acknowledgements

TREND
StG-2016
716510

DIGISMART
AdG-2018
787410

This work is funded by FEDER funds through the COMPETE 2020 Programme and National Funds through the FCT – Fundação para a Ciência e a Tecnologia, I.P., under the scope of the projects UIDB/50025/2020, and PTDC/NAN-MAT/30812/2017 (project NeurOxide). This work also received funding from the European Community's H2020 program under grant agreement No. 716510 (ERC-2016-StG TREND), No. 787410 (ERC-2018-AdG DIGISMART) and No. 685758 (1D-Neon).

MEON group (@CENIMAT)

chemosensors

an Open Access Journal by MDPI

IMPACT FACTOR 3.108

# Sustainable Metal Oxide Materials for Sensing Applications

**Guest Editors**

Dr. Ana Rovisco, Prof. Dr. Elisabetta Comini

**E-mail: a.rovisco@campus.fct.unl.pt**

**Deadline**

15 February 2021

Special Issue

mdpi.com/si/51820

**Invitation to submit**