New technologies and materials for inventive water treatment - NOWELTIES

Joint PhD Laboratory for New Materials and Inventive Water Treatment Technologies. Harnessing resources effectively through innovation

N. Skoro[1], B. Kalebic[2], A. Kumar[2], C. Sánchez Tobón[3]

[1] *Institute of Physics Belgrade, Serbia*

[2] *Faculty of Technology and Metallurgy, University of Belgrade, Serbia*

[3] *Faculty of Mechanical Engineering and Naval Architecture, University of Zagreb, Croatia*

Nowelties
European Joint Doctorate

MSCA ITN – EUROPEAN JOINT DOCTORATE (EJD)

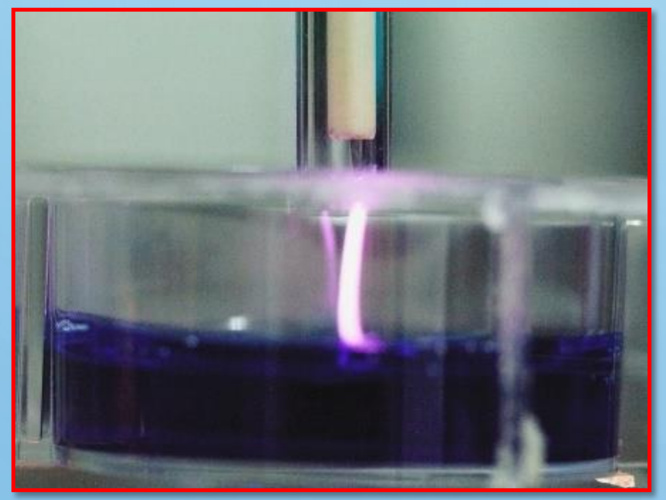
Future challenges, including climate change and the resulting unpredictability of precipitation patterns and temporal or permanent water scarcity, generate a high diversity of demands on water treatment technologies obliging them to be able to cater towards a variety of source and target water qualities across multiple scales, depending on application. It is evident that this will generate a market pull towards the development of new water treatment technologies, employing new materials or improving the integration of existing technologies. However, the integration of research and innovation within the water sector needs to be supported by education of a new generation of interdisciplinary trained wastewater professionals able to face future challenges and implement wastewater-related directives in practice.

Amit Kumar, ESR 4

Design, development and characterization of atmospheric plasma system for wastewater treatment

Interest in the use of **atmospheric plasma technology**, as one of the advanced oxidation processes **(AOPs)**, for organic micropollutants (such as **organic dyes, pesticides, pharmaceuticals**, etc.) removal from wastewater.

The **plasma discharge** leads to formation of radicals (HO•, H•, O•, etc.), molecules (H_2O_2, O_3, etc.), ions, excited species, etc. **Hydroxyl radicals (HO•)** have been examined as the major important reactive oxygen species in AOPs because it has a significantly **higher oxidation potential** in comparison with other oxygen-based reactive species.



Atmospheric cold plasma jet for wastewater treatment.

Barbara Kalebic, ESR 7

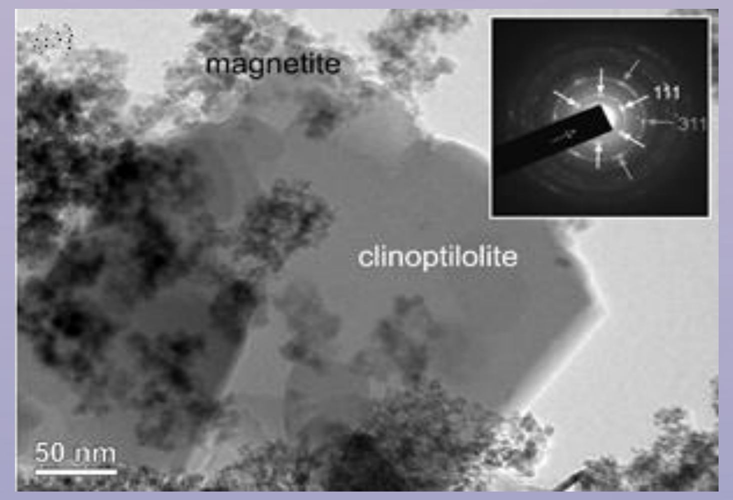
Surface modification and functionalisation of natural zeolite – clinoptilolite

Adsorption proved to be a one of the most appropriate processes for water treatment because of its **ease of operation** and the accessibility, with a wide range of adsorbent materials. Among various adsorbents, **natural zeolite – clinoptilolite (CLI)** as low cost and available material, shows excellent adsorption properties for removal of different OMPs.

Novel **clinoptilolite-based composites** will be prepared by modification of the CLI surface using:

- **magnetite nanoparticles (Fe_3O_4);**
- **graphene oxide;**
- **biopolymer chitosan** as well as
- **eco-friendly plasmas**

in order to achieve an enhanced removal efficiency for the selected type of OMPs – **antibiotics**.

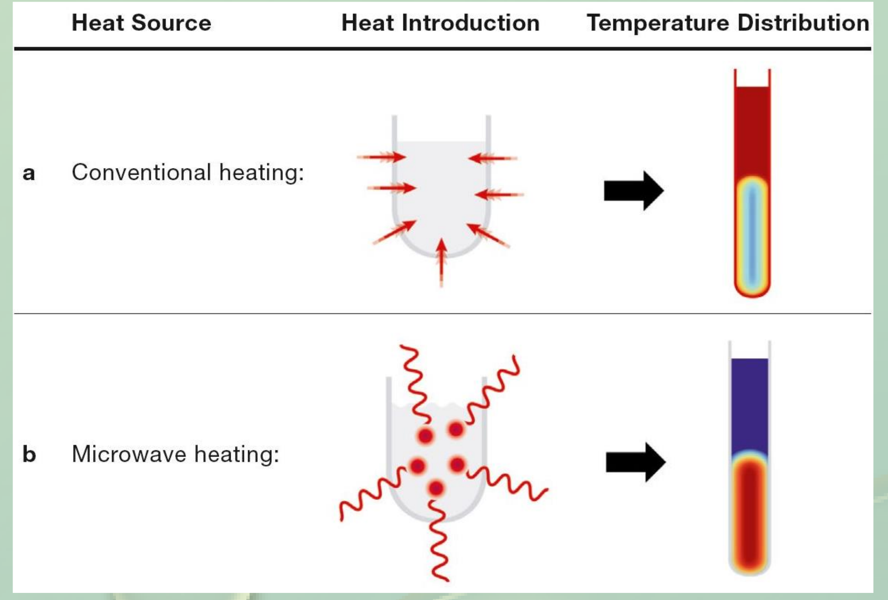


TEM image of magnetite containing clinoptilolite: black flakes – Fe_3O_4; hexagonal plates – CLI.

Camilo Sanchez, ESR 8

A green microwave - assisted synthesis of based TiO_2 composites for visible light-induced photocatalysis

TiO_2 heterogeneous photocatalysis, which is one of the **AOPs,** has been considered as a great alternative for **removal of OMPs** due to its capacity to produce strong oxidizers when it is irradiated by light. Photoactivation of TiO_2 occurs only under **UV light** and the photogenerated charges that start oxidation processes, recombine quite fast, affecting the photocatalytic activity. Thus, modification of TiO_2 with different elements (metals, non-metals or carbon materials) is the most common strategy used to produce an **energetically efficient material** for OMPs removal. This research proposes the microwave-assisted technology for synthesis of TiO_2 composites with low bandgap energy and increased **visible-light-driven photocatalytic activity**. This non-conventional synthesis technology produces homogeneous material in shorter reaction time with higher production yields, allowing to reduce the production's energy consumption.



Comparison microwave vs conventional heating. *"Courtesy of Anton Paar GmbH, Graz, Austria"*.

Coordinator	Beneficiaries							
ICRA – Catalan Institute for Water Research, Girona, Spain	**USC** – University of Santiago de Compostela, Spain	**RWTH** – RWTH Aachen University, Germany	**TUM** – Technical University of Munich, Germany	**UNIZAG-FKIT** – Faculty of Chemical Engineering and Technology, University of Zagreb, Croatia	**UNIZAG-FSB** – Faculty of Mechanical Engineering and Naval Architecture, University of Zagreb, Croatia	**TMF** – Faculty of Technology and Metallurgy, University of Belgrade, Serbia	**IPB** – Institute of Physics Belgrade, Serbia	**UNIFE** – University of Ferrara, Italy

Partner organizations					
UdG – University of Girona, Spain	**FHNW** – University of Applied Sciences and Arts, Northwestern Switzerland	**HERA**, Italy	**Cetaqua**, Spain	**Aqualia**, Spain	**CWT** – Comprehensive Water Technology, Croatia

Acknowledgement NOWELTIES Project has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Sklodowska-Curie grant agreement No. 812880