Merge of sonophotocatalysis and composite materials for addressing contaminants of emerging concern in water remediation

Hugo Salazar, Amaia Zarandona, Eneko Sebastian, Jorge, Saiz, Qi Zhang, Senentxu Lanceros-Mendez

The presence of contaminants of emerging concern (CECs) in water poses significant risks to human health and ecosystem biodiversity due to their persistence, bioaccumulation, and potential to disrupt biological processes [1]. Thus, there is an urgent need for advanced materials and technologies to address these resilient contaminants.

Sonophotocatalysis, which integrates ultrasonic waves (sonocatalysis) and light irradiation (photocatalysis), enhances the generation of reactive oxygen species (ROS), leading to improved degradation of CECs [2]. To maximize this effect, we develop composite materials designed to enhance the efficiency and stability of the sonophotocatalysis. In particular, we focus on the development of hybrid catalysts incorporating bismuth-based materials with two-dimensional (2D) materials like graphene oxide (GO), carbon nitride (C_3N_4), and MXenes.

These composite materials offer interesting characteristics in this context, including increased surface area, enhanced light absorption, and improved charge separation. The synergy between sonocatalysis and photocatalysis in these composites results in higher degradation rates of CECs compared to traditional methods. Our research highlights the synthesis, modification, characterization, and evaluation of these hybrid catalysts, demonstrating their effectiveness in degrading a range of CECs under various conditions. By merging sonophotocatalysis with advanced composite materials, we aim to provide a sustainable and efficient solution for water remediation, addressing the urgent need for improved treatment technologies to protect human health and the environment.

References

1. You, Q. et al. Defects controlling, elements doping, and crystallinity improving triple-strategy modified carbon nitride for efficient photocatalytic diclofenac degradation and H_2O_2 production. Applied Catalysis B: Environmental 321, 121941 (2023);

2. Iqbal, M. A. et al. Advanced photocatalysis as a viable and sustainable wastewater treatment process: A comprehensive review. Environmental Research 253, 118947 (2024).