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BiOBr/LECA as novel sunlight-driven device for drug photodegradation: harnessing sustainability as a keystone to help vulnerable communities

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Nowadays, preserving freshwater is crucial, especially in developing countries, where the risk of disease transmission is elevated.[1] Ibuprofen (IBU) and diclofenac (DCF) are nonsteroidal anti-inflammatory drugs (NSAIDs), whose concentration in surface waters is increasing due to the rapid growth/aging of world population.[1] So, the possible purification/reuse of wastewater represents a challenging task. Among the strategies to abate NSAIDs, photocatalysis exploits solar energy - a free and clean resource. Its potential is to significantly aid the development of regions frequently impoverished and densely populated, demonstrating a practical application of renewable energy in enhancing global water quality. However, the most part of photocatalytic systems hides a practical limitation, *i.e.*, the difficult recovery as powders from the reaction mixture, causing contamination issues and additional costs. In this context, sustainable floating photocatalysts are viable alternatives to be used: their floatability on the air-water interface maximizes both light absorption and surface aeration, enhancing pollutant removal efficiency and reducing post-treatment costs.[1] However, finding a simple, cheap, and universally accessible method for applying photocatalysis in water purification, especially in communities with limited access to clean water, remains an ongoing challenge.

Herein, we propose the development of an innovative sunlight-driven device composed by bismuth oxybromide (BiOBr) grown on a naturally derived material (Lightweight Expanded Clay Aggregate, LECA), to clean surface waters under natural solar irradiation. Photodegradation of IBU and DCF was investigated in laboratory- and real-scale experiments. The BiOBr/LECA photocatalyst fully degrades DCF, whereas restricted abatement of IBU is observed (Figure).[1] The identification of specific transformation products (TPs) during the degradation reveals that this behaviour is related to the different structures of drugs. Reusability tests demonstrate the high stability of the floating composite. These encouraging results pave the path toward a promising novel and sustainable paradigm for water remediation. In this way, the existing limitations can be overcome, advancing the field of water purification.

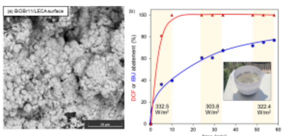

Figure: (a) FESEM images; (b) Real-scale photodegradation of 3:1 w/w drugs mixture (10 $mg \cdot L^{-1}$, simulated drinking water, 60 g BiOBr11/LECA) under natural solar light (daily medium irradiation from Milan meteorological station).[2]

References:

[1] M.G.Galloni, E.Falletta, M.Mahdi, G.Giordana, A.Cerrato, D.C.Boffito, C.L.Bianchi, Adv. Sus. Syst. 2024, 2300565.
[2] Arpa Lombardia, https://www.arpalombardia.it/temi-ambientali/meteo-e-clima/form-richiesta-dati/.