Solar piezo-photocatalysis: a powerful approach for organic pollutants mineralization

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The global market of wastewater treatment is increasing fast. In fact, the rapid growth and aging of world population has caused a drastic increase in foods and drugs demand, causing a dramatic pollution of water sources [1]. Different approaches have been proposed for the treatment of this type of waste. Among them, heterogeneous photocatalysis has emerged since it can potentially mineralize organic contaminants to CO2 and H2O [2]. However, the fast photo-induced electron-holes recombination limits its use, leading to the diffusion of the produced charges at the photocatalyst surface, strongly reducing the photocatalytic activity. To overcome this limitation, the development of photocatalytic materials able to reach the complete and fast pollutants mineralization by sustainable approaches is thus evident. Herein, the combination of different techniques can help in enhancing the process efficiency, reducing the formation of hazardous by products. Piezophoto-catalysis is an interesting strategy that requires a proper photo-piezoelectric catalyst for degrading pollutants in wastewaters. In this frame, ultrasound (US) vibrations promote the formation of an internal electric field in the material, enhancing in this way the photoinduced charge separation. The free charges accumulated at the material surface promote redox reactions involved in the degradation of organic pollutants [3].
According to this scenario, the present work focuses on the fast and efficient mineralization of bismuth oxybromide nanosheets (BiOBr) as a solar piezophotocatalyst for ibuprofen degradation in ultrapure or simulated drinking water. Results reveal that at low BiOBr concentration (0.125 g/L) good mineralization efficiency is reached (ca. 45%), increasing up to 100% when BiOBr content increases up to 0.50 g/L. Additionally, when 0.25 g/L catalyst is used as dosage, an important synergic effect in the mineralization process is observed, demonstrating the fast mineralization process that reaches more than 60% final mineralization value after 30 min. All experiments carried out demonstrate that the combination of US with photocatalysis enhances the IBU degradation by BiOBr, through boosting charge separation, reducing particle aggregation, improving the availability of active sites, promoting mass transfer between the catalyst's surface and the solution reaction and active the radical formation.

Keywords
Ultrasound-assisted photocatalysis, drug mineralization, bismuth oxybromide

References
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