

## Evaluation of photoexcited charge carriers of CdS/TiO<sub>2</sub> heterojunction for photocatalytic hydrogen production

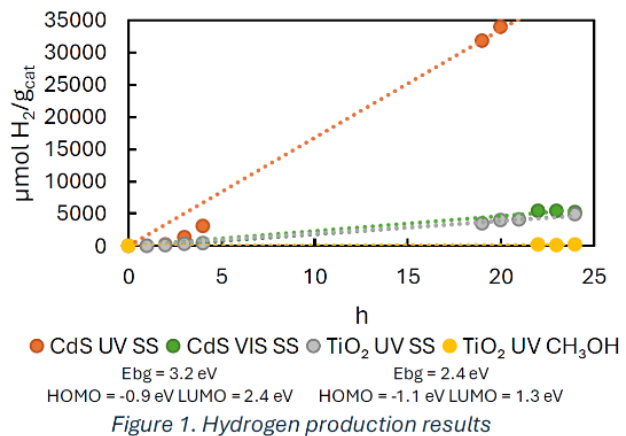
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**Introduction:** The energy crisis resulting from the intensive use of fossil fuels and the scarcity of renewable energy sources is one of the challenges of the 21st century. In this context, the search for efficient and sustainable technologies becomes crucial. Photocatalysis for hydrogen production is being investigated as a promising technology. It uses sunlight and seawater without any pre-treatment. To achieve high efficiency, it is essential to synthesize photocatalysts with improved charge transfer mechanism and the ability to operate under visible light, such as CdS/TiO<sub>2</sub> heterojunction. In addition, sacrificial agents are crucial in the photocatalysis, preventing photocorrosion and minimising charge recombination. The current research aims to understand the charge transfer mechanisms in the CdS/TiO<sub>2</sub> exposed to seawater, using two different sacrificial agents.

**Materials and Methods:** CdS/TiO<sub>2</sub> composite is synthesised by a hydrothermal method and characterised by cyclic voltammetry. The photocatalysis is carried out using a batch mode photo-reactor system (Apria Systems S.L.), with seawater under Ar atmosphere and exposed to visible (VIS) and ultraviolet (UV) light. Two sacrificial agents are evaluated: 20% CH<sub>3</sub>OH and 0.1 M Na<sub>2</sub>S/0.1 M Na<sub>2</sub>SO<sub>3</sub>. The samples are analysed in a GC-2010 gas chromatograph. In addition, the production of <sup>•</sup>OH radicals are analysed using an Agilent 1100 HPLC.

**Results and discussion:** Figure 1 shows that under VIS light, only CdS is activated, causing e<sup>-</sup> to migrate from the VB of CdS to the CB. With Na<sub>2</sub>S/Na<sub>2</sub>SO<sub>3</sub>, the e<sup>-</sup> migrate to the CB of TiO<sub>2</sub> and participate in the reduction of H<sup>+</sup> to H<sub>2</sub>, while H<sup>+</sup> accumulates in the VB of CdS, regenerating the CdS. With CH<sub>3</sub>OH, no H<sub>2</sub> is produced due to the exclusive excitation of the CdS under VIS light, leading to recombination of e<sup>-</sup>/H<sup>+</sup> pairs. Under UV light, both catalysts are activated, allowing charge transfer via a conventional scheme (type II) or Z scheme.



Since H<sub>2</sub> production occurs with both sacrificial agents, an analysis of <sup>•</sup>OH radicals are carried out. After 240 minutes, radical generation continues to increase due to water oxidation. These radicals indicate that the oxidation reactions take place in the TiO<sub>2</sub> holes, confirming the charge transfer through the Z scheme.

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