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Photocatalysts for Green Hydrogen Production: Electrochemical and Morphological Study

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Introduction: Climate change is one of the most pressing challenges that faces our planet. The production of green hydrogen through the use of photocatalytic materials activated by sun, is among the emerging technologies that contribute to decarbonizing the energy sector. TiO2 is commonly used as a photocatalyst, but has limitations such as large bandgap and fast charge recombination. A heterojunction between TiO2 and CdS promotesthe activation of the catalyst under visible light and can increase H2 production. To better understand the properties of these materials, it is necessary to carry out athorough morphological, surface and electrochemical characterization. The present investigation aims to understand the behaviour of CdS, TiO2 and CdS/TiO2 heterojunction catalysts using some of these characterization techniques.

Materials and Methods: CdS/TiO2 composite has been synthesized by a hydrothermal method. Morphological characterization has been carried out by scanning electron microscopy using a Carl Zaiss microscope, model EVO MA 15, equipped with an Oxford energy dispersive spectroscopy microanalysis system. Electrochemical characterization has been carried out by cyclic voltammetry and electrochemical impedance spectroscopy using a three electrode system with KHCO3 0.5 M as the electrolyte. The instrument used for these measurements is a Metrohm Hispania PGSTAT 302N potentiostat.

Results and discussion: The SEM results show a plume-like morphology for CdS, while TiO2 shows agglomerations of the material. In the heterojunction it can be observed that both materials are present and well dispersed throughout the sample, maintaining the original morphology. Figure 1 shows the band gap, HOMO and LUMO values obtained for each material and the Nyquist plots corresponding to the impedance analyses. It can be seen that TiO2 has higher resistance to charge transfer with a value of 167.75 Ω while for the composite it has a value of 1.37 Ω, therefore the use of CdS/TiO2 can improve the production of green hydrogen as it reduces charge recombination.

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