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Photocatalytic properties of TiO2@Fe3O4 nanocomposite surfaces deposited by combined Langmuir and Atomic Layer Deposition techniques

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Since solar energy is the most abundant and sustainable reservoir of energy on earth, there is a tremendous scientific effort to find an efficient way for it to substitute our strong dependency on fossil energy. This is where photocatalytic reactions such as hydrogen/oxygen evolution reaction (Photo Water Splitting) have shown important improvements and hold great expectation. The efficient conversion solar energy into molecular hydrogen, in a cheap and reliably way, is at the forefront of energy research to this date, demanding the fabrication of competitive and reliable nanomaterials with tunable properties. Titanium dioxide (TiO2) and magnetite (Fe3O4) composites have been previously shown promising results in simple mixtures, although showing poor stability overtime and rapid degradation.
Herein, the study aims to investigate the photocatalytic properties of the synthesized TiO2@Fe3O4 nanocomposites. Magnetite Nanoparticles were deposited by Langmuir technique on ITO substrates, TiO2 coating (3 nm) was deposited by ALD technique. Optical (UV-VIS) and structural (XRD, TEM) studies were carried out in order to assess the quality of the samples, While their photocatalytic performance was studied by cyclic and linear voltammetry (CV/LV) and electrochemical impedance spectroscopy (EIS). As a result, it was observed that the synthesized TiO2@Fe3O4 nanocomposite annealed in nitrogen at 300˚C showed the highest stability over time, as well as a clear decrease on resistance upon its irradiation, allowing efficient photoinduced charge separation and transport to the collecting ITO substrate. Results show the promising aspects of the nanocomposites and the deposition techniques used, clearly showing the importance of thermal annealing on the overall performance of nanocomposites prepared.

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