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Optimization of ZnO nanorods thin film photocatalyst for hydrogen production

To avoid ZnO photo-corrosion, In-doped ZnO nanorods were grown using the chemical bath deposition technique, varying the In concentration (0.5, 0.75, and 1 mol%). The increase in the indium load enhanced the photocatalytic activity in the hydrogen production, evolving ten times more hydrogen in the ZnO-NRD/1-In (1% In) sample. Unfortunately, after the recyclability cycles (three cycles), the ZnO-NRD/1-In film decreased its photoactivity by 90%, and the ZnO-NRD/0.5-In film (0.5% In) kept constant its gas evolution, evidencing stability. This decrease in the photocatalytic efficiency in the samples with larger load of In could be associated with the presence of In3+ species, which can act as electron scavengers that trap electrons in the ZnO CB and form oxidant species, causing the ZnO photo-corrosion. Finally, the photocatalytic stability of ZnO-NRD/0.5-In film (0.5% In) was tested for 72 hours, reaching a maximum hydrogen evolution at 48 h (up to 90 µmol). Despite this, during the third day of the irradiation, the hydrogen production did not increase, possibly due to a loss in the film surface caused by the turbulence in the reaction media. Additionally, after 72 hours of irradiation, it is possible to observe the presence of In over the film surface (EDS results), while the XPS results show that the film has the presence of In3+ species, which could contribute to the photocatalyst deactivation, decreasing the hydrogen production of the film.

Keywords

ZnO nanorods, photocorrosion, hydrogen production, photocatalysis.

Reference

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Author approval

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