Enhanced Photocatalytic Hydrogen Production Under Visible Light over Ag Doped TiO_2

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ABSTRACT

TiO_2 is the most widely used photocatalyst for water and air purification, and for hydrogen production, due to its good properties such as chemical and photo-corrosion resistance and low cost. One disadvantage of this material, resides in its bandgap energy (3.2eV), which lies in the UV spectrum. For this reason, studies have been conducted to modify TiO_2 bandgap into the visible light range. Doping elements used for this purpose are noble metals such as Au, Pt and Ag. However, Au and Pt are expensive and scarce materials, leaving Ag as a preferred candidate. TiO_2 and doped TiO_2 were synthesized via Sol-Gel/hydrothermal (SGH) named TiO_2-F and TiO_2Ag-F, respectively, while under the Sol-Gel/hydrothermal/thermal (SGHT) technique was named as TiO_2Ag-C, using titanium butoxide as a precursor and ethanol as solvent. XRD characterization resulted in the presence of the anatase phase in all three synthesized samples as well as the characteristic signals for Ag in TiO_2Ag-F. Samples crystal sizes were determined by the Scherrer equation, and were ~ 10 nm. Light absorption exhibited a shift in the Eg value from 3 eV for TiO_2-F to 1.98 eV for TiO_2Ag-F. TGA indicates the presence of residual organic material for samples synthesized through the SGH technique. BET surface area for the SGH and SGHT photocatalysts were of 140 and 90 m^2/g, respectively. SEM images presented particle agglomerates of irregular morphology. Photocatalytic evaluation for hydrogen production was performed using a 250 W mercury light lamp, filtering the UV spectrum. TiO_2Ag-F was the only sample that showed activity, producing 175 µmol of H_2/g catalyst over an 8-h irradiation period. This activity can be mainly attributed to the ability of this material to be activated under the visible light spectrum.

Keywords: TiO_2 doped Ag;, Water splitting; Hydrothermal method.

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