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Enhance Photoactivity of Hydrogen production with mixed oxide: TiO_2-NiO as semiconductor

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ABSTRACT

The most studied processes at the present for the hydrogen production are electrochemical, steam reforming of alcohols or hydrocarbons and water splitting. Thus, the water splitting using semiconductors materials had recently acquired great relevance because of the low cost for the hydrogen production. The principle of this technique is based on the photoexcitation of the semiconductor using a UV or visible light sources.

The alternative method of photocatalytic water splitting is promising since it involves the absorption of light to produce hydrogen by irradiating oxide semiconductors. Photocatalytic systems for water splitting may contain sacrificial reagents, as methanol, commonly used in the photocatalytic evolution of H_2 from water, since its hydroxyl group captures photogenerated holes and minimizes the probability of e^-/h^+.

In this study, Titanium dioxide doped with Nickel (1.0, 3.0, 5.0 and 10.0 % wt) by sol-gel method were obtained. The solids were characterized by nitrogen adsorption using adsorption isotherm (BET) and porosity (BJH) method, XRD patterns and UV-Vis spectroscopy. The photoactivity was evaluated using a Pyrex reactor of 200 ml using a solution Methanol-Water (1:1) and 0.1 g of catalyst. A high pressure Hg lamp (with a λ=254 nm, I_o = 2.2 mW/cm^2) encapsulated in a quartz tube was used as source of energy.

The results showed materials with specific surface area among 100 to 180 m^2/g and mesopority characteristics. The XRD patterns show the formation of the crystalline anatase phase. The band gap energy (Eg) for the materials were obtained with UV-Vis spectroscopy, the Eg values were lower than 3.2 eV. In the water splitting evaluation a maxim in the efficient was found at Ni at 10 wt.%. The hydrogen produced was 3000 μmol.

Keywords: Photocatalysis; hydrogen production; sol-gel; Titanium dioxide.