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$KNbO_3$ as Photocatalyst for Hydrogen Production

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ABSTRACT

Semiconductor photocatalytic water splitting to produce hydrogen from solar energy has been considered as one of the most important approaches in achieving an energy based sustainable development. A large number of semiconductor materials have been proposed as photocatalysts for water splitting to hydrogen. The pervoskite-structure compounds have attracted wide attention over the past half a century. $MNbO_3$ (M = Li, Na or K) is a pervoskite oxide with unique physical and chemical properties such as low density, high sound velocity, photorefractive effect and photoactivity. These materials have presented remarkable photocatalytic activity for water splitting and environmental purification. Moreover, potassium niobate ($KNbO_3$) submicro-crystals were prepared by a soft chemical method and characterized by powder X-ray diffraction, nitrogen adsorption–desorption, diffuse reflectance UV–visible spectroscopy, and scanning electron microscopy. The photocatalytic performance was evaluated toward H_2 generation from an aqueous methanol solution (2%Vol) under UV and Vis light using a 250 W mercurial lamp as an irradiation source. XRD results found that synthesized $KNbO_3$ presented an orthorhombic rhombohedral phase. Crystallite size was estimated using the XRD data and the Debye-Scherrer equation, reaching ~43.4 nm. From UV–visible spectroscopy it was found that $KNbO_3$ exhibited a band gap energy of 2.98 eV. The BET surface area of the synthesized sample was 1.80 m^2/g. Photocatalytic activity of potassium niobate presented a hydrogen production of 350 µmol/$g_{catalyst}$ using a reactor loading of 200 mg of photocatalyst under a 5 h irradiation time. Results from this study indicate that $KNbO_3$ perovskite is potentially applicable for the production of H_2 through photocatalytic water splitting.

Keywords: $KNbO_3$; Hydrogen production; Photocatalysis