SOLAR HYDROGEN PRODUCTION FROM AQUEOUS SOLUTIONS

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ABSTRACT

The generation of hydrogen from water splitting using photo-catalytic surfaces of oxide materials has been recognized since the early seventies. In the last decades interest in semiconductor photocatalysis has grown significantly, with works mostly referring to uses in water/air purification.

The photo-catalytic production of hydrogen by means of irradiation of a suspension of semiconductor oxides, presents attractive features over other methods with higher cost such as water electrolysis.

Some of the materials properties and requirements for solar hydrogen production include tailored electronic structure: band gap - essential for absorption of solar energy; and flat band potential - must be higher than the redox potential of the couple H^+/ H_2. Furthermore, efficient charge transport is necessary since low electrical resistance is required as well as effective charge separation and prevention of electron-hole pair recombination.

Nanostructured semi-conductor materials based on titanium dioxide, with effective photo-catalytic properties under UV illumination, were synthesized and characterized by X-Ray diffraction and scanning electron microscopy, with the objective of studying the photo-catalytic hydrogen production from water. The need to decrease the electron-hole recombination rate was accounted for by metal doping and the addition of ethanol as a hole trap. Aqueous suspensions of the semiconductor powders, with noble metal loadings (Pt) of 1.5 wt% were used and the effect of solution pH and temperature (20-70ºC) on hydrogen production were studied, for a selected catalyst concentration. Hydrogen production rates were found to be linear with solution temperature with values larger than published literature data.