Assessment of clean H2 energy production from water using novel silicon photocatalyst

ABSTRACT

Nanosheets of silicon have attracted a great deal of attention due to its tunable optical and electronic properties. However, the development of facile and easily scalable synthesis process has remained a great contest. Endeavor has been made in this research to find a waste inferred effective photocatalyst to deliver hydrogen (H2) through visible light responsive water splitting.

One-pot solid phase reaction was applied to synthesis catalyst and adopted ultrathin structure. The photocatalytic efficiency of catalyst was examined by XRD, XPS, and UV–VIS absorption spectra, PL, FESEM, HRTEM and EDX. The HRTEM and FESEM images revealed the interconnected nanosheets with Si having the average thickness of 5 nm and their band gaps were 2.3–2.5 eV corresponding to the absorption of visible light range. The H2 production rate on photocatalyst was originated to 3200 μmol h^{-1} without utilizing any conciliatory electron givers, voltage or pH alteration, which beats the Pt, Ru, Rh, Pd and Au stacked photocatalyst ever detailed up until this point. The significant increase in photocatalytic activity could be the fast charge migration and separation from the silicon-hydrogen and silicon-hydroxyl bonds on Si surface and facilitation of charge separation could results from the multiple reflections of visible light on ultrathin nanosheets. It has been confirmed that the electron/hole recombination rate in ultrathin nanosheets of Si declined due to the oxidation of Si surface. It would be presumed that the approach of surface chemistry of silicon could not be limited towards the photocatalytic water splitting and could be applicable to remedy water pollution.