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SYNTHESIS OF VISIBLE LIGHT RESPONSIVE CU(OH)$_2$ LOADED ZNIN$_2$S$_4$ PHOTOCATALYST FOR PRODUCTION OF RENEWABLE HYDROGEN BY NON-SACRIFICIAL WATER SPLITTING

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The conversion and storage of solar energy in the form of hydrogen (H_2) is a clean, affordable and sustainable fuel to meet the future energy requirement. Semiconductor based photocatalytic system for splitting of water under light irradiation is widely recognised as a sustainable method to produce H_2. Different stable oxide semiconductors have been used hitherto; however, their H_2 production efficiency is poor, due to their low visible light response, the position of conduction band (CB) potentials, rapid recombination of photogenerated electrons and holes. As a result, various visible light responsive materials have been developed, among those ternary chalcogenides like zinc indium sulphide ($ZnIn_2S_4$) has displayed excellent visible light photocatalytic activity for the required reactions. It is endowed with a CB potential (~0.8-1.1 eV) higher than the H_2 (H^+/H_2, 0 V) evolution potential and a lower band gap (~2.2 eV). However, their low charge separation efficiency tends to decrease the net H_2 production efficiency. To overcome this, different co-catalysts were loaded, among those, transition metal hydroxide ($M(OH)_2$ where, M-Co, Ni, Cu) has been reported as an effective co-catalyst for H_2 evolution. However, the water splitting reactions are studied mainly in the presence of sacrificial agents such as alcohols, Na_2S, Na_2SO_3, triethanolamine. The use of sacrificial agents is not useful for practical applications as it is economically not viable. Therefore, herein we describe the synthesis of visible light responsive $Cu(OH)_2$ loaded $ZnIn_2S_4$ photocatalyst for non-sacrificial water splitting to produce H_2, for the first time. $Cu(OH)_2$-$ZnIn_2S_4$ was synthesized via a facile hydrothermal method followed by precipitation and the samples were characterized using various physico-chemical techniques. The H_2 production efficiency of photocatalyst was investigated by non-sacrificial water splitting under visible light irradiation. The results revealed that $Cu(OH)_2/ZnIn_2S_4$ showed enhanced H_2 production capacity than the pristine $ZnIn_2S_4$. This is attributed to the efficient separation of the charge carriers and the boosted catalytic activity of surface sites. This work would further lift the interest in developing visible light responsive photocatalysts for non-sacrificial solar water splitting.

BIOGRAPHY

Thillai Sivakumar Natarajan has completed his PhD from CSIR-CSMCRI, Gujarat, India, in 2014 and then moved to South Korea and Taiwan for his Post-doctoral research and worked there until August 2016. In November 2016, he moved to Ireland and has been working as a Post-doctoral Researcher at School of Chemical and Bioprocess Engineering, University College Dublin, Ireland, under an Irish Research Council through Government of Ireland Post-doctoral Fellowship-2016 scheme. His research work mainly focuses on development of photocatalytic nanomaterials and surfaces and their use with different light sources (UV, solar and LED) in slurry and immobilized photocatalytic reactors for environmental remediation and energy applications. He has 20 research papers in internationally reputed journals and 4 book chapters. His publications have been cited over 800 times with the H-index of 12.

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