International Journal of Hydrogen Energy 91 (2024) 673–682

Contents lists available at ScienceDirect

International Journal of Hydrogen Energy

journal homepage: www.elsevier.com/locate/he

Green hydrogen production through photocatalytic seawater splitting on MS_2/TiO_2 (M=Ni/Co/Sn) nanocomposites over simulated solar irradiation

Sivagowri Shanmugaratnam [a,b,**], Punniamoorthy Ravirajan [b], Yohi Shivatharsiny [b,c,***], Dhayalan Velauthapillai [a,*]

[a] Faculty of Technology, Environment and Social Sciences, Western Norway University of Applied Sciences, P.O. Box 7030, 5020, Bergen, Norway
[b] University of Jaffna, Jaffna, 40000, Sri Lanka
[c] Augustana University, Sioux Falls, SD, 57197, USA

ARTICLE INFO

Handling Editor: Jinlong Gong

Keywords:
Photocatalysts
Metal chalcogenides
Titania
Water splitting
Sea water

ABSTRACT

Green hydrogen will play an important role in reducing carbon emission in sectors like transportation, power supply, and industry. However, for it to become competitive technology, the costs related to hydrogen production must be reduced. Photocatalytic hydrogen production is one of the green hydrogen production methods that have the potential to become cost effective. So far, photocatalytic water splitting has mainly focused on hydrogen production from pure water systems, but it is practically attractive to study methods for seawater systems, which will make better use of available natural resources. In this study, we focus on the synthesis and characterization of a variety of metal dichalcogenide-embedded titanium dioxide (NiS_2/TiO_2, CoS_2/TiO_2, SnS_2/TiO_2) nanocomposite materials as photocatalysts for seawater splitting. The materials were synthesized using a facile hydrothermal method and were used for simulated seawater, seawater and deionized water splitting with 4 h of simulated solar illumination. The amounts of 48.11, 24.94, 15.04, and 2.78 $mmolg^{-1}$ hydrogen were successfully produced with NiS_2/TiO_2, CoS_2/TiO_2, SnS_2/TiO_2, and pristine TiO_2 nanomaterials, respectively. Highest amount of H_2 with NiS_2/TiO_2 photocatalyst can be attributed to the low bandgap of NiS_2, which acts as a co-catalyst. Our study clearly demonstrates that low-cost, noble-metal-free nanocomposite photocatalysts could be promising candidates for realizing efficient solar-to-hydrogen conversion from seawater splitting.