

Green and facile synthesis of strontium doped Nb₂O₅/RGO photocatalyst: Efficacy towards H₂ evolution, benzophenone-3 degradation and Cr (VI) reduction

K. Yogesh Kumar^a, M.K. Prashanth^b, H. Shanavaz^a, L. Parashuram^c, Fahad A. Alharti^d, Byong-Hun Jeon^{e,*}, M.S. Raghu^{f,*}

^a Department of Chemistry, Faculty of Engineering and Technology, Jain University, Bangalore 562112, India

^b Department of Chemistry, BNM Institute of Technology, Banashankari, Bangalore 560070, India

^c Department of Chemistry, Nitte Meenakshi Institute of Technology, Yelahanka, Bangalore 560064, India

^d Department of Chemistry, College of Science, King Saud University, Riyadh 11451, Saudi Arabia

^e Department of Earth Resources and Environmental Engineering, Hanyang University, 222, Wangsimni-ro, Seongdong-gu, Seoul 04763, Republic of Korea

^f Department of Chemistry, New Horizon College of Engineering, Outer Ring Road, Bangalore 560103, India

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ABSTRACT

A simple co-precipitation method has been developed to synthesize Nb₂O₅/reduced graphene oxide nanocomposite (NbO/RGO). The effect of various % of strontium doping on NbO/RGO was studied. The characterization results for its structure; morphology confirms the decoration of NbO with RGO followed by Sr doping resulting in Sr@Nb/R-wt% nanocomposite. Various % of Sr has been doped to NbO/RGO and evaluated for photocatalytic H₂ evolution, degradation benzophenone-3, and Cr(VI). Enhanced H₂ evolution was observed in Sr@Nb/R-0.75% nanocomposite (1925 μmol) and found three and two times greater than pristine NbO and NbO/RGO, respectively. Sr@Nb/R-0.75% nanocomposite was able to degrade 94.6 and 87.7% of BP and Cr(VI) respectively.

1. Introduction

Industrialization and urbanization across the globe have led to a huge demand for energy which is causing energy scarcity and environmental pollution indirectly. The energy sources like fossil fuels need alternate sources of energy that can meet the energy demand and reduce environmental contamination [1]. Hydrogen is a fuel that burns with zero emission with high energy density. Classical hydrogen evolution utilizes Pt, Ru, and Pd as electrocatalysts which are costly and consume lot of energy in the form of electricity [2]. Recently, photocatalytic hydrogen evolution technology has gained high prominence due to its eco-friendly nature, no electricity consumption etc. [3].

Along with the energy sector, environmental pollution particularly water treatment needs lot of improvement. Water contamination due to the accumulation of heavy metals, Cr(VI), personal care products, synthetic dyes, pesticides, and insecticides causes ecological imbalance and is a threat to living beings [4]. People use many organic compounds in their day to day life like, cosmetics, shampoo, hair spray, deodorant,

perfumes, detergents, makeup, etc. These are covered under a separate class of pollutants of emerging concern since their impact is not explored and they are not regulated [5]. UV filters like Benzophenone-3 (2-hydroxy-4-methoxyphenyl) phenylmethanone) are extensively used in sunscreen lotions, cosmetics etc. by human beings to avoid exposure to UV radiations. BP is an organic UV filter that can only absorb specific wavelength range of radiation and hence offer protection to the skin. BP and other personal care products are made to discharge into the water bodies and soil without any concern [6]. This leads to environmental pollution which persists for a longer time due to the complex structures and causes ecological imbalance. BP has been identified in surface water, swimming pools as well as in fish. BP of 10% concentration in sunscreen could penetrate the human body in several hours and disrupts the endocrine, nervous system, hormonal system etc. [7]. Chromium is an inorganic compound that has been used extensively in leather industries, electroplating, mining, etc. The toxicity of Cr is high in its Cr (VI) state compared to Cr(III) state. The upper limit for Cr(VI) in water is 0.05 mg L⁻¹ beyond this leads to cancer, liver damage etc. [8]. By

* Corresponding authors.

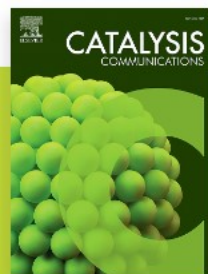
E-mail addresses: bhjeon@hanyang.ac.kr (B.-H. Jeon), dr.msraghu@newhorizonindia.edu (M.S. Raghu).

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