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Photocatalytic CO_2 reduction and pesticide degradation over g-C_3N_4/Ce_2S_3 heterojunction

Mohd Ubaidullah [a,*], Abdullah M. Al-Enizi [a,*], Ayman Nafady [a], Shoyebmohammad F. Shaikh [a], K. Yogesh Kumar [b], M.K. Prashanth [c], L. Parashuram [d], Byong-Hun Jeon [e,*], M.S. Raghu [f,*], Bidhan Pandit [g]

[a] Department of Chemistry, College of Science, King Saud University, 11451 Riyadh, Saudi Arabia
[b] Department of Chemistry, Faculty of Engineering and Technology, Jain University, Bangalore, 562112, India
[c] Department of Chemistry, BNM Institute of Technology, Banashankari, Bangalore, 560070, India
[d] Department of Chemistry, Nitte Meenakshi Institute of Technology, Yelahanka, Bangalore 560064, India
[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
[g] Department of Materials Science and Engineering and Chemical Engineering, Universidad Carlos III de Madrid, Avenida de la Universidad 30, 28911, Leganés, Madrid, Spain

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ABSTRACT

The ecosystem is being exposed to a huge amount of CO_2 as a result of excessive usage of fossil fuels. Global ecological imbalance is a result of this. In addition to being a pollutant, CO_2 has the potential to be converted into beneficial carbonaceous products when exposed to light and thereby supporting the two important sectors of energy and the environment. Hence, authors in the present work describes the fabrication 1:1 ratio of g-C_3N_4-Ce_2S_3 (GCN/CeS) heterostructure through solvothermal approach. The spherical CeS surrounding the sheet-like GCN heterostructure is confirmed by microscopic characterization. It is found that GCN and CeS have bandgap of 2.68 and 2.06 eV, respectively. In comparison to pristine CeS and GCN, enhanced selective CO_2 was seen in the GCN/CeS heterostructure for 6 h (H_2-123.9, CO: 166.8 and CH_4:236.4 µmol g^{-1}). The higher activity seen in GCN/CeS is supported by photoelectrochemical and optical characterizations. Additionally, the hazardous herbicide Atrazine (ATZ) was subjected to light-driven degradation using synthesized materials, and the reaction conditions were tuned for maximum effectiveness. Under visible light, a 95% degradation of ATZ was observed in the GCN/CeS heterostructure. Liquid chromatography-mass spectroscopy (LC-MS) analysis was carried out to deduce the degradation pathway and mechanism of ATZ degradation. The enhanced activity in GCN/CeS could be attributed to formation of heterojunction between GCN and CeS with a bandgap of 2.29 eV. ATZ degradation was evaluated under different conditions like varied water matrices, anions, and cations that affect photocatalysis. The GCN/CeS heterostructure's high degree of stability demonstrates its effectiveness in photocatalytic processes.

1. Introduction

The melting of ground-covered ice, increasing sea levels, droughts, and bleaching of large-scale coral reefs all signal that global warming is on the way, and that it will have a significant impact on the global ocean circulation system [1,2]. From an energy standpoint, these type of severe climatic changes are mostly attributed to the global energy imbalance caused by significant CO_2 emissions as long as people continue to use fossil fuels for energy [3,4]. Hence, people need to concentrate more to reduce and stabilize carbon dioxide emissions through agriculture, forestry, and other cutting-edge technologies in order to restore and maintain energy balance [5,6]. Although fossil fuels remain the primary source of energy used by humanity today, the development of new renewable energy sources, such as hydrogen energy, will enable us to tackle the problem of global warming [7,8]. A great efforts have been made in the field of photocatalytic CO_2

* Corresponding authors.
E-mail addresses: mtayyab@ksu.edu.sa (M. Ubaidullah), amenizi@ksu.edu.sa (A.M. Al-Enizi), bhjeon@hanyang.ac.kr (B.-H. Jeon), raghuhassan2009@gmail.com (M.S. Raghu).

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