Effective photocatalytic degradation of dye pollutant using in-situ synthesized S-doped inverse opal graphtic carbon nitride

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Keywords: Inverse opal, Carbon nitride, Degradation, Organic pollutants

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Abstract

Non-biodegradable or persistent organic pollutants, such as tetracycline (TC) as an antibiotic or Rhodahmine B (RhB) as a dye, adversely impact on water, human health and ecosystem. Many researchers around the globe have been attractive in finding effective degradation methods of these pollutants. Recently, photocatalytic oxidation is receiving significant attention for its ability to degrade those pollutants effectively. However, conventional photocatalysts such as TiO2 have been limited by their high energy consumption requiring UV due to their non-response to visible light, limited photocatalytic performance due to easy recombination of photogenerated electrons and holes, and low surface area available for active sites. One strategy to overcome these limitations is to develop a visible light response photocatalyst using an inverse opal (IO) technique. The IO technique can utilize a photonic crystal material with periodic interconnected 3D macroporous structure that increases specific surface area and the exposure to active sites to improve mass-transfer efficiency and enhances light-harvesting capability. This study successfully developed an inverse opal sulfur-doped graphitic-carbon nitride photocatalyst (IO-S-g-C_3N_4 : IO-S-CN) using an in-situ technique using IO structure of size-controlled SiO2 spheres, a precursor of thiourea, melamine and additional treatments. IO-S-CN exhibited excellent photocatalytic activity for RhB degradation in water as compared with inverse opal g-C_3N_4 (IO-CN), sulfur doped-g-C_3N_4 (S-CN), and bulk g-C_3N_4 (bulk-CN). Thus the developed photocatalyst can be considered as a sustainable wastewater treatment technique for effective removal of dye pollutants in water.

References

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Acknowledgement

This work has been performed with the financial assistance (year 2022) of Ulsan Green Environment Center (UGEC), KOREA.