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Improving the performance of the photocatalytic activity of Cu and S co-doped TiO_2 nanoparticles

Kondarage Y. G.[1*], Senarathna K. G. C.[2]

[1]*Department of Engineering Technology, Faculty of Technology, University of Ruhuna, Kamburupitiya, Matara, Sri Lanka*

[2]*Department of Biosystems Technology, Faculty of Technology, Uva Wellassa University, Badulla, Sri Lanka*

Photocatalyst is a light-activated catalyst. Metal complexes and semiconductor catalyst are recognized as photocatalyst materials. Titanium Dioxide (TiO_2) has become the most important material due to its high chemical stability, non-toxicity, inexpensiveness and efficient photoactivity. However, due to its wide band gap and the fast recombination of electron-hole pair, it has contributed to the inability to use the sunlight sufficiently as well as hindering for any reaction to happen. To utilize visible light more efficiently in Photocatalytic reactions, it was objected to prepare, Copper and Sulfur co-doped anatase phase TiO_2 nanoparticles with different ratios by a sol-gel method via a precursor solution of titanium isopropoxide. The powder XRD pattern confirmed that all the synthesized pure and doped TiO_2 nanoparticles samples were polycrystalline of anatase phase. Ti-O bonds in the samples were confirmed through FTIR spectrum. The average particle size determination and elemental analyses were done by SEM coupled with EDX spectroscopy. The photocatalytic activity of the synthesized catalysts was investigated against degradation of methylene blue solution under visible light using UV-visible spectroscopic techniques. The optimal photocatalytic activity was obtained at the 100:0.25:0.25 Ti^{4+}:Cu^{+}:S^{2-} molar ratio. Photocatalytic properties were further improved by doping with $CaCO_3$ to reduce the carrier recombination. The performance was optimized at 100:0.25:0.25:0.25 Ti^{4+}:Cu^{+}:S^{2-}:Ca^{2+} molar ratio. The experimental work conducted here revealed promising results for improving the performance of the TiO_2 nanomaterial by doping it with copper and sulfur where the photocatalytic activity was enhanced and shifted to the visible region causing an appreciable increase in its effectiveness for photocatalytic applications.

Key words: *Titanium Dioxide, co-doping, photocatalyst*

*Corresponding author: yashodha@etec.ruh.ac.lk