# Preparation and Characterization of Copper and Sulfur Co-Doped Titanium Dioxide Nano Particles as an Enhanced Photocatalytic Material

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Photocatalyst is a substance, which can modify the rate of the chemical reaction using light irradiation. Among the various oxide semiconductor photocatalyst, 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 bandgap 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, Copper and Sulfur co-doped anatase phase $TiO_2$ nanoparticles with different ratios were prepared by a sol-gel method via a precursor solution of titanium isopropoxide. The powder X ray diffraction 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 furrier transform infrared spectrum. The average particle size determination and elemental analyses were done by scanning electron microscopy coupled with energy dispersive x-ray spectroscopy. The photocatalytic activity of the synthesized catalysts were 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.

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