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Photocatalytic Degradation of Methylene Blue Dye Using Cuprous Oxide/Graphene Nanocomposite

Authors : Bekan Bogale, Tsegaye Girma Asere, Tilahun Yai, Fekadu Melak

Abstract : Aims: To study photocatalytic degradation of methylene blue dye on cuprous oxide/graphene nanocomposite. Background: Cuprous oxide (Cu2O) nanoparticles are among the metal oxides that demonstrated photocatalytic activity. However, the stability of Cu2O nanoparticles due to the fast recombination rate of electron/hole pairs remains a significant challenge in their photocatalytic applications. This, in turn, leads to mismatching of the effective bandgap separation, tending to reduce the photocatalytic activity of the desired organic waste (MB). To overcome these limitations, graphene has been combined with cuprous oxides, resulting in cuprous oxide/graphene nanocomposite as a promising photocatalyst. Objective: In this study, Cu2O/graphene nanocomposite was synthesized and evaluated for its photocatalytic performance of methylene blue (MB) dye degradation. Method: Cu2O/graphene nanocomposites were synthesized from graphite powder and copper nitrate using the facile sol-gel method. Batch experiments have been conducted to assess the applications of the nanocomposites for MB degradation. Parameters such as contact time, catalyst dosage, and pH of the solution were optimized for maximum MB degradation. The prepared nanocomposites were characterized by using UV-Vis, FTIR, XRD, and SEM. The photocatalytic performance of Cu2O/graphene nanocomposites was compared against Cu2O nanoparticles for cationic MB dye degradation. Results: Cu2O/graphene nanocomposite exhibits higher photocatalytic activity for MB degradation (with a degradation efficiency of 94%) than pure Cu2O nanoparticles (67%). This has been accomplished after 180 min of irradiation under visible light. The kinetics of MB degradation by Cu2O/graphene composites can be demonstrated by the second-order kinetic model. The synthesized nanocomposite can be used for more than three cycles of photocatalytic MB degradation. Conclusion: This work indicated new insights into Cu2O/graphene nanocomposite as high-performance in photocatalysis to degrade MB, playing a great role in environmental protection in relation to MB dye.

Keywords : methylene blue, photocatalysis, cuprous oxide, graphene nanocomposite
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