Green synthesis of copper nanoparticles and Their Modification with Polyethylene Glycol to enhance photocatalytic activities

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Abstract. Synthesis using plant extracts is a simple, environmentally friendly and inexpensive method to prepare nanoparticles effective in photocatalytic applications. In this study, aqueous extract of lemon peel was used to synthesize copper oxide nanoparticles (NPs) and then the obtained copper oxide nanoparticles were modified with polyethylene glycol (PEG). The optical properties and photocatalytic activities of the synthesized nanoparticles were studied. CuO NPs and CuO/PEG NPs showed a ball-like morphology with average sizes of 34 nm and 45 nm and optical band gap energies of 1.2 eV and 1.5 eV, respectively. In photocatalytic activity tests, CuO/PEG NPs showed higher activity compared to CuO NPs alone. They achieved degradation rates of 99.7% for 4-bromophenol dye (BP) and 99.5% for toluidine blue dye (TP) after 90 min, while CuO NPs achieved slightly lower rates. CuO NPs and CuO/PEG NPs showed significant photodegradation activity against amoxicillin (an antibiotic), with degradation rates of 91% and 98%, respectively, after 120 min. The reaction kinetics of CuO/PEG NPs and CuO NPs followed a pseudo-order model, with CuO/PEG NPs showing a higher rate constant than CuO NPs. Overall, modification of CuO NPs with PEG showed excellent photocatalytic properties for environmental remediation, indicating their potential use in wastewater treatment and therapeutic applications.

Keywords: Green synthesis, copper nanoparticles , Polyethylene Glycol , photocatalytic activities.