Enhanced multifunctionality of CuO nanoparticles synthesized using aqueous leaf extract of Vernonia amygdalina plant

ABSTRACT

We report the synthesis of medicinal plant, Vernonia amygdalina Del. mediated green copper oxide nanoparticles (VeA-CuO NPs). The presence of two absorbance maxima, λmax 1 and λmax 2 at 436 nm and 452 nm, respectively confirms a mixture of biomolecules surface amalgamated CuO NPs with different morphological features. The FT-IR spectra of the plant leaf extract and VeA-CuO confirmed the efficient role of biomolecules as capping and stabilising agents. The XRD patterns of NPs approved high crystallinity of CuO. The purity of the NPs was corroborated by SEM-EDAX analysis. The average particle size of the NPs was found to be 19.68 nm. In addition, the combined TEM, HRTEM and SAED analysis substantiated the presence of CuO with a d-spacing value of 0.2854 nm, which conformed to CuO (1 1 1). The antibacterial assay revealed that VeA-CuO NPs were synergistic in their influence versus bacterial strains, S. aureus, E. coli, P. aeruginosa, and E. aerogenes. The uppermost zone of inhibition of 15 mm was observed for E. aerogenes. The bioactive compounds capped around the CuO NPs served the effective role in disrupting the cell wall of bacterial strains. The degradation efficiencies for Indigo carmine (IC) and Malachite green (MG) dyes by NPs were found to be 95% and 91%, respectively. The lowest degradation half-life was recorded to be 16.55 min for MG dye. In addition, the better electrode stability revealed by CV and EIS studies, confirms the multi-functional nature of VeA-CuO NPs, these CuO NPs exhibited multifunctional applications.

Keyword: CuO NPs; Vernonia amygdalina Del.; Photocatalyst; Antibacterial activity; Cyclic voltammetry