Photocatalytic performance of a novel semiconductor nanocatalyst : copper doped nickel oxide for phenol degradation

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ABSTRACT

In this study, the degradation of phenolic compounds was performed in the presence of pure and Cu doped nickel oxide (Cu–NiO) nanocatalysts. A wet chemical method was utilized for the catalyst preparation. The crystallinity and phase were determined using X-ray diffraction, optical properties were analyzed by UV–Vis spectroscopy and morphology was analyzed by a transmission electron microscope. Fourier transform infrared spectroscopy confirms the formation of pure NiO and the existence of copper in doped nanocatalyst samples. Cu–NiO nanocatalyst samples showed a reduction in average crystallite size as compared to pure NiO sample, where it was 24.0, 22.8 and 19.03 nm for 2Cu–NiO and 4Cu–NiO, respectively. The average particle size as determined by using transmittance electron microscopy were about 28.0, 26.6 and 22.8 nm for NiO, 2Cu–NiO and 4Cu–NiO, respectively. In addition, the energy bandgap values were found to be 3.26, 3.64 and 3.87 eV for undoped NiO, 2Cu–NiO and 4Cu–NiO, respectively. Comparative study of the photocatalytic performance of Cu–NiO and pure NiO were systematically performed at various reaction times and Cu doping ratios (2–4 wt %). Different molar concentrations of phenol were also considered for this study. The obtained results showed that the Cu–NiO nanocatalyst exhibited the highest phenol degradation efficiency as compared to their undoped counterpart. This material is first reported and successfully used in efficient removal of phenol from real industrial effluent. The nanocatalyst efficiency for phenol removal was tested in real leather industrial wastewater effluent which could remove about 85.7% within 150 min.

KEYWORDS

Copper doped NiO; Nanocatalyst; Photodegradation; Phenol; Water treatment

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