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Solar-driven photocatalytic degradation of phenol in aqueous solution using visible light active carbon-modified (CM)-n-TiO_2 nanoparticles

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ABSTRACT

Visible light active carbon-modified (CM)-n-TiO_2 nanoparticles were synthesized by sol/gel method. Carbon modification of n-TiO_2 was performed during the synthesis process by using titanium butoxide as a carbon source in addition of being a molecular precursor of TiO_2. When compared to unmodified n-TiO_2, CM-n-TiO_2 nanoparticles exhibited significantly higher photocatalytic activity toward the photocatalytic degradation of phenol in aqueous solution under illumination of both UV light and real sunlight. Carbon modification was found to be responsible for narrowing the bandgap energy of CM-n-TiO_2 from 3.14 to 1.86 eV. The effects of catalyst dose, initial concentration of phenol, and pH on the degradation kinetics of phenol were investigated. The highest degradation rate of phenol was obtained at the optimal conditions of pH 5 and 1.0 g L^{-1} of CM-n-TiO_2. The photocatalytic degradation of phenol using CM-n-TiO_2 obeyed a pseudo-first-order kinetics according to the Langmuir–Hinshelwood model.

Keywords: Photocatalytic degradation; Phenol; Titanium oxide; Carbon modification