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Synthesis, characterization and photocatalytic activity of Ag metallic particles deposited carbon-doped TiO_2 nanocomposites supported on stainless steel mesh

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Abstract

In this present work, post deposition of metallic Ag nanoparticles on carbon-doped TiO_2 nanocomposites supported on stainless steel mesh was achieved via a combination of sol–gel and thermal evaporation techniques. Poly acrylonitrile dissolved in dimethyl formamide and titanium tetra chloride was used as a carbon and titanium precursor, respectively. The photocatalytic activity of the prepared supported catalysts was evaluated by the degradation of an aqueous solution of methylene blue as a model pollutant under ultra-violet light irradiation. The prepared photocatalysts were characterized by several analytical techniques such as high resolution transmission electron microscopy, energy dispersive X-ray spectroscopy, Brunauer–Emmett–Teller measurements, X-ray photoelectron spectroscopy and X-ray diffraction. The XRD patterns and HRTEM micrographs confirmed the formation of a highly crystalline pure anatase TiO_2 phase irrespective of the deposited metallic Ag particles. The Brunauer–Emmett–Teller N_2 adsorption–desorption analysis revealed that the specific surface area of supported carbon-doped TiO_2 nanocomposites without silver was 152 and 160 m^2/g for metallic Ag deposited carbon-doped TiO_2 nanocomposites. The X-ray photoelectron spectroscopy profile of the photocatalysts revealed the existence of Ti in oxidation state of +4 and metallic Ag in zero state, respectively. The results revealed that the percentage methylene blue removed was dependent on the amount of silver deposited and the catalyst surface area. The supported metallic Ag particles deposited carbon-doped TiO_2 nanocomposites demonstrated 10.8% higher activity than the carbon-doped TiO_2 nanocrystals without metallic Ag. The excellent reusability and stability of the Ag deposited carbon-doped TiO_2 nanocomposites and high photocatalytic behavior after four consecutive applications was determined and methylene blue removal rate was maintained.

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Graphical Abstract