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ORIGINAL PAPER

# Lanthanum/Cadmium/Polyaniline bimetallic nanocomposite for the photodegradation of organic pollutant

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**Abstract** In the present research paper, La/Cd/Polyaniline nanocomposite (La/Cd/PANI BNC) was prepared by simple reverse micelles micro-emulsion technique. The nanocomposite of La/Cd bimetallic nanoparticles with polyaniline is fabricated using graft copolymerization method. The materials were well characterized using various modern instrumentations such as transmission electron microscopy (TEM), scanning electron microscopy (SEM) and Fourier transform infrared (FTIR) spectroscopy. The SEM micrographs clearly revealed the granular and spherical structural morphology of La/Cd BNPs, whereas La/Cd/PANI (La/Cd/PANI BNC) had needle-shaped crystal embedded with spherical La/Cd BNPs. The transmission electron micrographs (TEM) of the bare La/Cd BNPs showed that most of the bare La/Cd particles were 20 nm in diameter. The optical band gap of La/Cd bimetallic nanoparticles was found to be 3.04 eV which lies in semiconductor range. Thus, materials could find applications in semiconductor devices and spintronic. The incorporation of bimetallic nanoparticles into polyaniline matrix led to further lowering of band gap to 2.77 eV. The materials were also explored for their photocatalytic behavior against toxic organic dye in water system. Both the samples successfully degraded the methylene Blue dye in presence of sunlight. However, La/Cd/PANI BNC was more effective in the removal of dye with a whopping 92.14 % degradation achieved in 5 h.

**Keywords** Bimetallic nanoparticles · Emulsion polymerization · Photocatalysis · Nanocomposite

## Introduction

A novel class of materials known ‘bimetallic nanoparticles’ have been thoroughly investigated, for their applications in diverse fields such as sensors, drug delivery and catalysis etc. The non-supported bimetallic nanoparticle suspensions, stabilized by ligands or polymers, or their nanocomposites with synthetic polymers still need to be studied in detail due to their unique properties [1–3]. Various preparative actions have been proposed, and a comprehensive characterization was also carried out on bimetallic nanoparticles and their nanocomposites, thus lying emphasis on new developments in their field. The bimetallic nanoparticles, composed of two different metals, have drawn a larger interest than monometallic nanoparticles due to their unique properties. The interaction among two metals plays a vital role in deciding the unique properties of bimetallic nanoparticles. It has been found that bimetallic nanoparticles had improved catalytic properties than individual metal particles [4]. These properties are different to those of pure elemental particles, and include unique size dependent, optical, electronic and catalytic effects as an extra degree of freedom is introduced when we go from monometallic to bimetallic nanoparticles. The bimetallic nanoparticles can have different architectures, including alloys, core–shell and contact aggregates etc. The organization of bimetallic combinations depends mostly on the preparation environment and the miscibility of the components. The bimetallic

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