SYNTHESIS AND CHARACTERIZATION OF CARBON QUANTUM DOTS/$CuFe_2O_4$ NANOHYBRID FOR WATER TREATMENT APPLICATIONS

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ABSTRACT

Water pollution control is a major environmental concern worldwide. To date, several technologies have been developed for water treatment; among them, adsorption is the most popular due to its simplicity and low cost. Over the past few decades, various materials, including activated carbon, alumina, zeolites and organic polymeric resins, have been employed as adsorbents for the removal of organic and inorganic pollutants from water. [1] Nowadays, the interest of the scientific community is increasing dramatically towards utilization of carbon-based nanomaterials in water purification, due to their significant properties. Carbon quantum dots (C-QDs), the last addition in the family of carbon nanoallotropes, offer tremendous opportunities for water treatment applications, due to low or non-toxicity, high specific surface area, good chemical stability and low-cost synthesis. Furthermore, due to the presence of a large number of functional groups on their surface, C-QDs provide many adsorption active sites. [2] However, C-QDs adsorbents cannot be easily retrieved from aqueous solutions after their use. Therefore, their combination with magnetic nanoparticles, such as copper ferrite ($CuFe_2O_4$) has been considered as an ideal option, since the C-QDs/$CuFe_2O_4$ adsorbent could be easily retrieved by applying an external magnetic field. [3]

Aim of this work is the synthesis and characterization of C-QDs/$CuFe_2O_4$ nanohybrid for the removal of organic dyes from water. In particular, the adsorbent was prepared via a three-steps method. Firstly, C-QDs were simply prepared by citric acid and urea precursors, using a domestic microwave. Then, they were freeze dried in order to obtain powder. Following this, C-QDs were combined with $CuFe_2O_4$ nanoparticles via a solvothermal method using $FeCl_3 \cdot 6H_2O$ and $CuCl_2 \cdot 2H_2O$ as starting materials. The process took place in a Teflon-lined autoclave at 200 ℃ for 12 h in the presence of ethylene glycol (EG), sodium acetate (NaAc) and poly ethylene glycol (PEG). The obtained magnetic C-QDs/$CuFe_2O_4$ nanohybrid material was characterized using X-ray powder Diffraction (XRD), Fourier Transformed Infrared Spectroscopy (FT-IR), Micro-Raman Spectroscopy, as well as, Transmission Electron Microscopy (TEM). Adsorption experiments were performed to evaluate the adsorption capacity and efficient removal of Congo Red dye of the C-QDs/$CuFe_2O_4$ nanohybrid using a UV-Vis spectrophotometer.

KEYWORDS: carbon quantum dots, copper ferrite, nanohybrid, water treatment

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