Comprehensive study on morphological, structural and optical properties of Cr2O3 nanoparticle and its antibacterial activities

ABSTRACT

Chromium (III) oxide (Cr2O3) nanoparticles are generated by thermal treatment (calcination) of precursor materials such as chromium nitrate along with a poly (vinyl pyrrolidone) capping agent. The samples produced were characterised by various techniques, including X-ray diffraction (XRD), energy dispersive X-ray spectroscopy (EDX), transmission electron microscopy (TEM) and Fourier transform infrared spectroscopy (FT-IR). Examination results obtained from XRD showed that Cr2O3 nanoparticles exhibit hexagonal crystalline structures, with the presence of Cr and O in these novel materials being confirmed by results of analyses of both EDX and FT-IR. Results of TEM have pointed out that the average nanoparticle size was noticeably increased from 28 to 46 nm in relation to increase of calcination temperature of a range between 500 and 800 °C. The surface composition and valence state of the produced nanoparticles were examined by X-ray photoelectron spectroscopy (XPS), the optical energy gap has been evaluated using UV–visible reflectance spectra with the help of Kubelka–Munk equation. The energy band gap had a reversely proportional relationship with calcination temperature with a reduction in energy band gap from 3.12 to 3.01 eV. Photoluminescence (PL) spectra indicated an increase in photoluminescence with increasing particle size. The antibacterial activity of the Cr2O3 nanoparticles was evaluated in-vitro using gram-negative Escherichia coli ATCC 25922 and gram-positive Bacillus subtilis UPMC 1175.