



Optimized routes for the preparation of gadolinium carbonate and oxide nano-particles and exploring their photocatalytic activity

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Received 08 September 2016; Accepted 26 February 2017

ABSTRACT

A sequence of organized precipitation test was conducted based on the Taguchi robust design so as to evaluate the best conditions for the preparation of $Gd_2(CO_3)_3$ nano-particles in the absence of common additives like surfactants, templates or catalysts, indicating that the dimensions of the product nano-particles can be manipulated merely through altering the parameters affecting the reaction. These parameters include the concentrations of Gd(III) and carbonate ions as well as the reactor temperature. The optimal reaction conditions led to the production of $Gd_2(CO_3)_3$ nano-particles of 36 nm in average diameter, which were evaluated by scanning electron microscopy (SEM), fourier transform infrared spectroscopy (FT-IR), thermogravimetric-differential thermal analysis, and UV-Vis spectrophotometry. $Gd_2(CO_3)_3$ was further calcinated at 700°C to decompose into spherical Gd_2O_3 nano-particles with average diameters below 25 nm, the formation of which was established by SEM, X-ray diffraction (XRD), and FT-IR techniques. In order to obtain the band gap energies of the fabricated carbonate and oxide nano-products, they were characterized by UV-Vis diffuse reflectance spectroscopy (DRS). Besides, the photocatalytic behaviors of the nano-products in degradation of methyl orange as a pollution of water were explored, and the results exhibited the efficacy of both products in eliminating of the organic pollutant.

Keywords: Nano-structures; Lanthanides oxide; Chemical synthesis; Photocatalyst; Gadolinium carbonate

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