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Synthesis and Characterization of Sm3+-doped ZnO Nanoparticles via a Sol–Gel Method and their Photocatalytic Application

Muneer M. Ba-Abbad[1,2,3], Mohd S. Takriff[1,2], Abdelbaki Benamor[4], Mustafa S. Nasser[4], Ebrahim Mahmoudi[1], Abdul Wahab Mohammad[1,2]

[1]Department of Chemical and Process Engineering, Faculty of Engineering and Built Environment, Universiti Kebangsaan Malaysia, 43600 Bangi, Selangor, Malaysia, [2]Research Centre for Sustainable Process Technology, Faculty of Engineering and Built Environment, Universiti Kebangsaan Malaysia, 43600 Bangi, Selangor, Malaysia, **[3]Department of Chemical Engineering, Faculty of Engineering and Petroleum, Hadhramout University of Science &Technology, Mukalla, Hadhramout, Yemen**, [4]Gas Processing Centre, Qatar University, P. O. Box 2713, Doha, Qatar.

Abstract: Spherical ZnO nanoparticles doped by samarium ions were successfully synthesized via a simple sol–gel method. The structures, morphologies, optical properties and surface areas were investigated for all samples using specific characterization methods. The hexagonal wurtzite structure of ZnO and samarium-doped ZnO nanoparticles were determined. The results obtained showed that the sizes of samarium-doped ZnO nanoparticles decreased with increasing samarium ion concentration. It was noticed that in the presence of samarium ions, the band gap slightly changed from the 3.198 eV of ZnO to 3.288 eV for samarium doped ZnO with enhanced absorption in the UV region. This can be attributed to the transition of electrons from the conduction band to the acceptor energy level of samarium. The XPS results of samarium-doped ZnO, showed that only one oxidation state of samarium, with good incorporation into the ZnO matrix, was presented, with no peak of samarium oxide. The surface areas analyses showed that higher surface areas were obtained for samarium-doped ZnO, which is attributed to the smaller size of the particles. The photocatalytic degradation of 2-chlorophenol was investigated under sunlight in presence of ZnO and samarium-doped ZnO nanoparticles. A higher performance of samarium-doped ZnO for photocatalytic degradation of 2- chlorophenol at 0.50 wt% was observed, compared to pure ZnO nanoparticles under the same experimental conditions.

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