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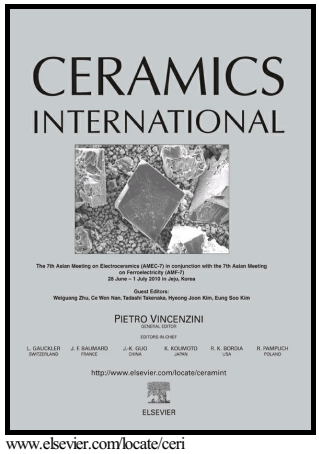

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ZnS nanoparticles prepared via simple reflux and hydrothermal method: optical and photocatalytic properties

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Abstract

In this research, zinc sulfide nanoparticles (NPs) with various morphologies such as spherical, flower-like, microspheres decorated with nanoparticles and nanorods were synthesized by two distinct, simple and efficient methods. These approaches include reflux and hydrothermal methods. Zinc nitrate hexahydrate ($Zn(NO_3)_2$).$6H_2O$ were used as Zn source and thioacetamide (TAA) was used as S source. The effects of TAA to zinc ion mole ratio were investigated on the morphology, particle size, optical and photocatalytic properties of ZnS nanocrystals. In hydrothermal synthesis with increasing Zn^{2+}:TAA mole ratio from 1:1 to 1:2 bone like nanocrystals changed to semi-spherical nanoparticles with average particle size 50-60 nm, with different effect as photocatalysts. But any change at morphology were didn't observed with changing Zn^{2+}:TAA mole ratio from 1:1 to 1:30 in the reflux method. In the reflux method with increasing in Zn^{2+}:TAA mole ratio, dispersed semi-sphere nanoparticles were observed. The synthesized nanocrystals were characterized by infrared spectroscopy (FT-IR), field emission scanning electron microscopy (FESEM), energy-dispersive x-ray spectroscopy (EDS) and X-ray diffraction (XRD) analysis. XRD analysis and FESEM images show that the size of synthesized ZnS NPs is in the range of 15-25 nm. UV-Vis spectra showed that by increasing the amount of sulfur source and increasing the reaction time, λ_{max} shifted towards lower wavelengths, and the band gap was in the range of ~3.9-4.8 eV for all of the samples. Also, photoluminescence (PL) analysis showed by increasing particle size and degree of agglomeration, emission intensity (λ_{em}) decreased. The photocatalytic activity of the as-prepared samples has been compared for