

Stabilization of Transition Metal Chromite Nanoparticles in Silica Matrix

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Abstract : This article presents summary on preparation and characterization of zinc, copper, cadmium and cobalt chromite nano crystals, embedded in an amorphous silica matrix. The ZnCr₂O₄/SiO₂, CuCr₂O₄/SiO₂, CdCr₂O₄/SiO₂ and CoCr₂O₄/SiO₂ nano composites were prepared by a conventional sol-gel method under acid catalysis. Final heat treatment of the samples was carried out at temperatures in the range of 900-1200 °C to adjust the phase composition and the crystallite size, respectively. The resulting samples were characterized by Powder X-ray diffraction (PXRD), High Resolution Transmission Electron Microscopy (HRTEM), Raman/FTIR spectroscopy and magnetic measurements. Formation of the spinel phase was confirmed in all samples. The average size of the nano crystals was determined from the PXRD data and by direct particle size observation on HRTEM; both results were correlated. The mean particle size (reviewed by HRTEM) was in the range from ~ 4 to 46 nm. The results showed that the sol-gel method can be effectively used for preparation of the spinel chromite nano particles embedded in the silica matrix and the particle size is driven by the type of the cation A²⁺ in the spinel structure and the temperature of the final heat treatment. Magnetic properties of the nano crystals were found to be just moderately modified in comparison to the bulk phases.

Keywords : sol-gel method, nanocomposites, Rietveld refinement, Raman spectroscopy, Fourier transform infrared spectroscopy, magnetic properties, spinel, chromite

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