ABSTRACT

Name of the Candidate : D. Shiney Manoj
Institution : S.T. Hindu College
Location : Nagercoil, Tamil Nadu, India
Submitted to : Manonmaniam Sundaranar University, Tirunelveli
Ph.D. Reg. No : 2471
Field of Study : Nanostructured Materials
Subject : Physics
Guided by : Dr. C.K. Mahadevan
Associate Professor of Physics
S.T. Hindu College, Nagercoil – 629002
Title of the Thesis : Preparation and properties of nanocomposites based on some manganese compounds
No. of Pages : xvii + 239

Keywords : Nanocrystals, Nanostructured materials, Magnetic semiconductors, Hausmannite, Composite materials, Catalyst, Multiphase, Paramagnetic materials, Trimanaganese tetraoxide, Manganese sulphide, Dilute magnetic semiconductors PXRD, Spectroscopy, Spectral measurements, Thermogravimetry, Differential thermal analysis, Optical bandgap, Debye- Scherrer formula, SEM, EDAX, ICP – OES, EPR, VSM, AC conductivity, DC conductivity, Dielectric constant, Dielectric loss.
Nanomaterials is an very essential material in our day to day life. So in recent years, there has been considerable interest generated in the study of nanomaterials in the nanometer range. Nanoscience is leading to a technological revolution in the new millennium. Also, the science underpinning nanotechnology is a multidisciplinary subject.

In the present work, we have attempted to prepare \((\text{MnS}_2)_x(\text{Mn}_3\text{O}_4)_{1-x}\) and 2.5 and 5.0 wt.% Zn\(^{2+}\) doped \((\text{MnS}_2)_x(\text{Mn}_3\text{O}_4)_{1-x}\) nanocomposites in different compositions by varying \(x = 0.0, 0.25, 0.5, 0.75, 1.0\) (a total of 15 samples) by a simple microwave assisted solvothermal method using a domestic microwave oven. The reaction time, colour, yield percentage and grain size were observed. The samples were characterized by PXRD, SEM, EDAX and ICP – OES to analyse the samples chemically and structurally. FTIR studies were made to find the functional groups present in the sample.

The thermal stability of the prepared nanocrystals, was understood by the thermal studies. The optical band gap energy of the prepared samples was determined by UV-Vis spectral studies. The magnetic nature of the sample was analyzed by VSM and EPR studies. All the samples prepared were subjected to AC and DC electrical measurements in order to characterize them electrically.

The results obtained in the present study indicate that multiphased nano-composites of pure and Zn\(^{2+}\) doped Mn\(_3\)O\(_4\) and MnS\(_2\) compounds and mixed compounds of Mn\(_3\)O\(_4\) and MnS\(_2\) at various compositions can be synthesized by a simple domestic microwave assisted solvothermal method. The colours of the synthesized samples are of with brown shades and the grain size varies from 11.59 to
43.63 nm. The incorporation of the dopant is clearly revealed by EDAX and ICE – OPS studies. The absorption band increases as the sulphur content in the composite is increased. The magnetic studies reveal the paramagnetic nature of the samples. The study indicates that the prepared nanocomposites of Mn$_3$O$_4$ and MnS$_2$ are expected to be useful in supercapacitor applications.