Nanocomposites and nanomaterials

Crystal structure of micro- and nanopowders of ZnS studied by EPR of Mn^{2+} and XRD

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The interest to zinc sulfide has recently increased due to the progress in the technologies that allow to obtain low-sized (LS) ZnS crystals on the scale from μm to a few nm. Doping with different (Cu, Mn, Co and Eu) impurities has the potential to broaden the range of useful spectroscopic (luminescent) properties that can be achieved from this class of materials. Changes of the properties of LS ZnS crystals are caused by both their small sizes and the specific features of their local structure, in particular, with local distortions of the crystalline lattice in the vicinity of impurity centers. In present study powders of ZnS:Cu, ZnS:Mn, ZnS:Co and ZnS:Eu with particle sizes of 5-7 μm, 50-200 nm, 7-10 μm and 5-7 nm, respectively, were studied by EPR of Mn^{2+} and XRD methods. Manganese was incorporated in crystal lattice of all samples as uncontrolled impurity or by doping. It was shown, that EPR of Mn^{2+} ions allows to obtained unambiguous information about the crystal structure of micro- and nanopowders of zinc sulfide. It is found that ZnS:Cu has cubic structure, ZnS:Mn has hexagonal structure with orthorhombic distortion, ZnS:Co is a mixture of cubic and hexagonal phases in a ratio of 1:10, ZnS:Eu has cubic structure and a distorted cubic structure with stacking defects in a ratio 3:1. EPR has incontestable advantages over other methods of structural analysis in study of mixed-polytypes zinc sulfide powders and objects containing small (less than 5 nm) zinc sulfide particles. Moreover, it gives information about local distortions of the crystal lattice being not available by other techniques.