Doping of ZnO Nanopowders with Mn^{2+} Ions at Ultrasonic Spray Pyrolysis

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The processes of ZnO nanopowders doped ions Mn^{2+}, obtained by ultrasonic spray pyrolysis. The synthesis of zinc nitrate solution and manganese at T = 670 °C. As carrier gas, air or nitrogen is used. Wherein the manganese concentration was equal to 2,4; 4,8; 9,6 and 38,4 at. %.

XR diffraction analysis method were established crystal structure, chemical composition and average size of nanocrystals ZnO:Mn. Doping was confirmed by ESR spectra by the presence of six lines of the hyperfine structure characteristic of the ions Mn^{2+} (Fig. 1). The possibility of nanopowders doped directly during synthesis, without additional annealing. In the synthesis of a microdroplet spray solution after the rapid heating transformed into spherical particles of a size from 1 to 2 microns. Each particle consists of a large number of nanoparticles as a mixture of the oxides ZnO and MnO_2. The average crystal size with increasing manganese concentration to 9.6 at.% decreases from 56 to 24 nm, respectively.

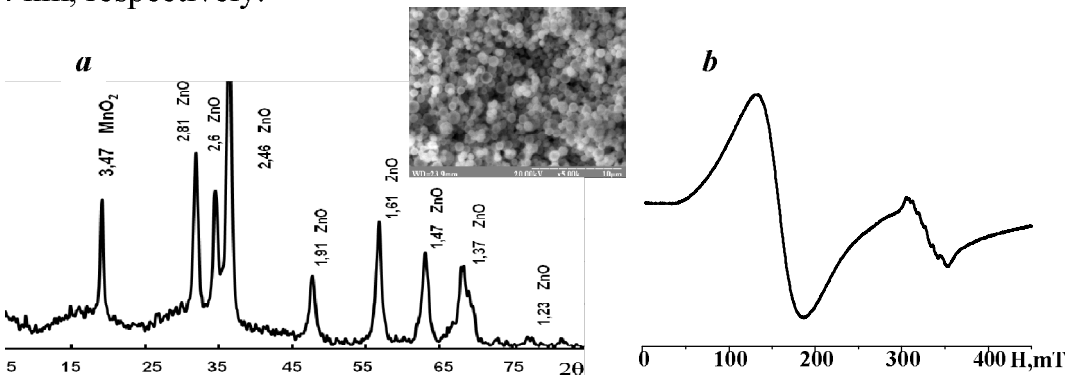

Fig. 1 Data of XR diffraction analysis (***a***) and EPR spectra nanopowder ZnO:Mn (***b***); the inset the form of the surface nanopowder.

The dependence of the final product from the synthesis of the carrier gas type. Nitrogen promotes the formation of a secondary phase MnO_2 powder at concentrations of manganese in excess of 2,4 at.%. In samples with manganese concentrations less than 2,0 at.% there is one phase of ZnO c wurtzite type crystal lattice. Studies nanopowder ZnO: Mn by ESR showed that when used as a carrier gas of nitrogen in the EPR spectra in small magnetic fields present broad absorption line with g = 4,2874 (Fig. 1). Perhaps, the presence of this line due to the formation of defects in crystals of ZnO, which occur during the formation of crystals under an inert atmosphere of oxygen deficiency. Such defects are the centers of the acceptor type, so the powder ZnO:Mn may have p-type conductivity.