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SUMMARY

Title: Effect of Co, Mn, and Cr Doping on the Electron Structure and Magnetic Properties of ZnO semiconductor

The aim of the dissertation was to obtain and characterize a new material, produced by gas phase deposition using a pulsed laser, in the form of a layer of zinc oxide doped with cobalt, manganese, or chromium ions, which exhibited ferromagnetic properties at the highest possible temperature. In particular, to study the effect of technological parameters for the fabrication of these layers on the value of the Curie temperature. The thesis presented various research techniques. Information about the electron structure was obtained from the optical spectra, from which, among other information, the values of the excited gap were calculated, and from electron magnetic resonance measurements. The obtained results of optical and magnetic properties of doped ZnO layers were developed and interpreted. The influence of process parameters, such as dopant concentration, substrate temperature, and annealing temperatures, on the optical and magnetic properties of the doped layer was demonstrated. An appropriate model of ferromagnetic interactions was used to characterize the magnetic properties of the fabricated doped ZnO layers. For the layer of ZnO + 20% Co on a quartz substrate, the highest Curie temperature value of 165.5 K was obtained. On the basis of the obtained results and data from the literature, it was proposed to modify the layer by adding noble metal nanoparticles. The process parameters for the fabrication of the modified doped ZnO layer were selected. Based on Becker's theory, the Curie temperature was estimated to be above 500 K for the silver-doped layer and above 300 K for the gold-doped layer, so a new material exhibiting ferromagnetic properties at room temperature or higher was obtained. Such layers can be used in electronic devices that use both spin and electron charge for processing, storage, or data transmission.

Keywords: zinc oxide, Curie temperature, electron magnetic resonance, DMS.

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