Raman spectroscopy of bulk $Zn_{1-x}Co_xO$ mixed crystals

W. Szuszkiewicz[1], J.F. Morhange[2], Z. Golacki[1], P. Skupinski[1], and K. Grasza[1]

[1]*Institute of Physics, Polish Academy of Sciences, Lotników 32/46, 02-668 Warsaw, Poland*
[2] *Institut des Nanosciences de Paris, CNRS, Université Paris VI et Paris VII*
140 rue de Lourmel, Paris 75015, France

Currently, ZnO-based diluted magnetic semiconductors (DMS) attract much attention, mainly because of the predicted possibility of ferromagnetism at 300 K. Among these materials, $Zn_{1-x}Co_xO$ takes a prominent position. In spite of numerous investigations, a general understanding of its magnetic properties is still missing. Moreover, its detailed behaviour depends on the sample type (bulk crystal, thin layer, ceramic sample, or nanocrystal) and treatment. In particular, post-growth annealing may modify its stoichiometry, type and density of defects, possible precipitates etc.

Lattice dynamics studies may be a key for studying these structural properties. We present a systematic analysis of such $Zn_{1-x}Co_xO$ properties by micro- and macro-Raman scattering from phonons for a wide variety of different sample parameters. Bulk mixed crystals with a composition corresponding to $x \leq 0.05$ were grown by physical vapour transport, and investigated between 1.6 K and 295 K. Both as-grown and annealed samples were studied for a comparison.

Beside the common eigenmodes of the ZnO host lattice, we observed disorder-induced lattice vibration modes and a structure, which is tentatively assigned to a local vibration mode of the Co impurity. We present their dependence on the composition, the applied preparation technique and the annealing process. Furthermore, the formation of precipitates and their possible impact on the magnetic properties is discussed. Our results are compared with literature data of other ZnO-based DMS, such as (Zn,Mn)O.

The work was partially supported by the Polish Grant No 3 708A 05128 and by the POLONIUM program No 7011/R07/R08.

Name of the presenting author (poster session II): Wojciech Szuszkiewicz
e-mail address: szusz@ifpan.edu.pl
http://www.ifpan.edu.pl