Magnetic and structual properties of Fe-doped ZnO

Ju-Hyun Kim, Sang-Ho Jin and Soon-Ju Kwon*

Department of Materials Science and Engineering, Pohang University of Science and Technology (POSTECH), San 31, Hyoja Dong, Nam Gu, Pohang, 790-784, South Korea (R.O.K)

*Corresponding author: e-mail: soonju@postech.ac.kr, Phone: +82-54-279-2137, Fax: +82-54-279-2399

Recently it is anticipated that transition-metal-doped ZnO base diluted magnetic semiconductor (DMS) might have a higher Tc than 300K, because hole doping is one of effective ways to increase Curie temperature (Tc) of a magnetic semiconductor [1]. We investigated (Fe, N)-doped ZnO powder. Samples were fabricated with solid-state reaction method in N-filled quartz tubes. The crystal structures were characterized by x-ray diffraction (XRD) and RAMAN spectroscopy. Electromagnetic properties were determined by alternating gradient magnetometer (AGM), Hall effect, and electron paramagnetic resonance (EPR). XRD pattern was of a typical ZnO without any evidence of a secondary phase. As the Fe doping concentration becomes higher, both the length of c-axis measured by XRD and E_2 phone frequency in Raman spectrum increase. The XRD result represents the amount of Fe substitutes Zn, where the Raman data indicate compressive stress built in the crystal. The results are plausible because the radius of substituted Fe ion is larger than that of Zn ion. Also Tc becomes higher to above the room temperature and the saturation magnetization increases. This is related to the spin configuration of Fe obtained from EPR spectrum peak. In summary, (Fe,N)-doped ZnO, supported by the hole-mediated super exchange coupling mechanism, has Tc above RT and should be a promising material to be a practical DMS.

References

[1] T. Dietl, H. Ohno, F. Matsukara, J. Cibert, and D. Ferrand, Science 287 1019 (2000)