ICAMD 2005

The 4th International Conference on
Advanced Materials and Devices

Dec. 5 ~ 7, 2005, Jeju, KOREA

Ramada Plaza Jeju Hotel

http://www.icamd2005.or.kr

PROGRAM & ABSTRACTS

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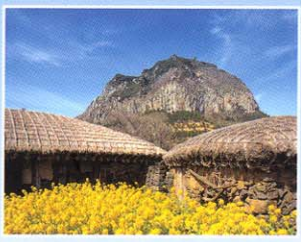

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2005년 세계물리의 해

[MAG-P05]

Diluted magnetic semiconductor of Co ion-implanted ZnO single crystals

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ZnO is a II-V compound semiconductor with a wide band gap energy (E_g = 3.35 eV) and is interesting from the viewpoint of forming a transparent ferromagnetic materials.[1] We have investigated the characteristics for magnetic semiconductor of Co ion-implanted ZnO single crystals by using high resolution x-ray diffraction (HRXRD), fluorescence x-ray absorption fine structure (XAFS) measurements, superconducting quantum interference device (SQUID) magnetometer, and photoluminescence (PL). 0.5 mm thick ZnO (0001) single crystals was prepared, and 80 KeV Co ions with a dose of 3×10^{16} cm^{-2} were implanted into ZnO at 350 ℃. The implanted samples were post-annealed at 700-900 ℃ by rapid thermal annealing (RTA) in N_2 atmosphere for 5 min to recrystallize the samples. X-ray diffraction results show the presence of Co impurities phase in the samples annealed at 700-900 ℃. Co K-edge x-ray absorption near-edge structure and extended x-ray absorption fine structure revealed the coexistence of Co-O and Co-Co bonds in the films. The magnetization curves and temperature dependence of magnetization taken in zero-field-cooling (ZFC) and field-cooling (FC) conditions showed the features of superparamagnetic system due to the presence of magnetic nanoclusters. The blocking temperature (T_B) increased with increasing annealing temperature. In the PL spectra obtained at 10 K, noticeable changes are observed in the spectra between unimplanted and as-implanted with post-annaneled samples. The transitions are currently assigned to free exciton (FX) and bound exciton (BX) with LO phonon replicas. After implantation and annealing procedures, the Near-band-edge (NBE) spectra are mainly dominated by the 3.358 eV emission (BX). In the PL spectra of temperature dependence for the samples annealed at 800 and 900 ℃, with an increase in temperature the bands at 3.358 eV shifted to the lower energy and the peak intensity reduced gradually.

[1] W. Prellier, A. Fouchet, and B. Mercey, J. Phys.: Condens. Matter 15, R1583 (2003).

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