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# 회보

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measurement of Co ion-implanted ZnO single crystals 김우철, 손병철, 박강순, 강희재, 오석근, 신상원<sup>1</sup>, 이종한<sup>1</sup>, 송종한<sup>1</sup>, 노삼규<sup>2</sup>, 오상준<sup>3</sup>, 박수현<sup>3</sup>, 김철성<sup>4</sup> (충북대학교 물리학과. <sup>1</sup>한국과학기술연구원. <sup>2</sup>한국표준과학연구원. <sup>3</sup>한국기초과학지원연구원. <sup>4</sup>국민대학교 나노전자물리학과.) We have investigated the

magnetic and AC transport properties of Co ion-implanted ZnO single crystals by using high resolution x-ray diffraction (HRXRD), superconducting quantum interference device (SQUID) magnetometer, and physical properties measurement system (PPMS). 0.5 mm thick ZnO (0001) single crystals was prepared, and 80 KeV Co<sup>+</sup> ions with a dose of  $3 \times 10^{16} \text{ cm}^{-2}$  were implanted into ZnO at 350 °C. The implanted samples were post-annealed at 700-900 °C by rapid thermal annealing (RTA) in N<sub>2</sub> atmosphere for 5 min to recrystallize the samples. X-ray diffraction results showed the presence of Co (111) impurities phase in the samples annealed at 700-900 °C. The magnetization curve 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<sub>B</sub>) increased with increasing annealing temperature. In electro-transport measurements, resistivity as a function of temperature revealed a typical semi-conducting behaviors and showed conduction via variable range hopping (VRH) at low temperature. Magnetoresistance (MR) property at 30 and 50 K, respectively for 800 and 900 °C-annealed samples showed positive MR response (nearly parabolic) centered at H = 0. In AC Hall measurements, anomalous hall effect (AHE) by n-type carrier is observed at low temperature.