第 5 回 CSIS セミナー
第 60 回ナノ・スピン工学研究会
半導体スピントロニクス研究室講演会の開催について

日　時：　平成 24 年 8 月 30 日（木）13:30-15:00
場　所：　電気通信研究所　ナノ・スピン総合研究棟 4 階　401 号室
講　師：　Professor H. Chou, National Sun-Yat-Sen University, Taiwan
講演題目：　Roles of transition ions and oxygen vacancies in $Zn_{0.95}Co_{0.05}O_{1-\delta}$ diluted magnetic oxides

概　要：

Hsiun Chou[1], Y. C. Tsao[1], M.-H. Tsai[1], C. P. Lin[1], S. J. Sun[2] and H. S. Hsu[3]

[1] Department of Physics, National Sun Yat-Sen University, Kaohsiung, Taiwan

[2] Department of Applied Physics, National Kaohsiung University, Kaohsiung, Taiwan

[3] Department of Applied Physics, National Pintung University of Education, Pintung 900, Taiwan

Dietl *et al.* proposed on 2000 that by proper diluted doping of Mn ions in wide band gap oxides, such as ZnO, these materials can exhibits ferromagnetism (FM) above room temperature. It is found that the doping of rare earth (RE) ions alone is not adequate to trigger FM coupling, coexistence of oxygen vacancies (V_O) are crucial. However, the role of RE doping and V_O on how ZnO films become room temperature FM and carry spin polarized current are puzzles yet to be understood. $Zn_{0.95}Co_{0.05}O_{1-\delta}$ films with fixed Co doping ratio and various oxygen vacancies, V_O, were grown to study this problem. Due to the strong AFM and FM competition, at room temperature, the $Zn_{0.95}Co_{0.05}O_{1-\delta}$ films is nonmagnetic when δ=0 and will become weak FM when δ is higher than a certain value. It is found that Co dopant possesses mostly its atomic 3d band structure around the ZnO band gap and serve as catalysis to polarize V_O contributing magnetic moments. The narrow 3d minority band strongly interacts with the narrow localized V_O states and the tailing part of the ZnO conduction band at Fermi level; a strong coulomb excitation triggers a substantial interaction and splits these bands and states into a upper conduction band (RUCB) band and a polarized and renormalized lower-localized band (RLLB). The RLLB consisted principally of V_O states and the Co 3d-$t_{2g\downarrow}$ band is polarized and cancels out the weak ferromagnetic moment. Higher the V_O concentration, more pronounce the canceling effect gives rose to an even weaker ferromagnetic moment. When V_O is higher than the percolation limit, the hopping mechanism dominates the electric conduction and acts as a spin polarized current. At low temperature where the thermal excitation vanishes, the hopping conduction becomes the only conduction mechanism such that the film becomes a half metallic film. The strength of magnetization is not necessary proportional to the percentage of spin polarized current.

問い合わせ先：電気通信研究所　大野研究室・山ノ内（片平5554）