Abstract Submitted
for the NWS10 Meeting of
The American Physical Society

Ferromagnetism in doped or undoped spintronics nanomaterials[1]

YOU QIANG, PHYSICS DEPARTMENT UI TEAM — Much interest has been sparked by the discovery of ferromagnetism in a range of oxide doped and undoped semiconductors. The development of ferromagnetic oxide semiconductor materials with giant magnetoresistance (GMR) offers many advantages in spintronics devices for future miniaturization of computers. Among them, TM-doped ZnO is an extensively studied n-type wide-band-gap (3.36 eV) semiconductor with a tremendous interest as future mini-computer, blue light emitting, and solar cells. In this talk, Co-doped ZnO and Co-doped Cu_2O semiconductor nanoclusters are successfully synthesized by a third generation sputtering-gas-aggregation cluster technique. The Co-doped nanoclusters are ferromagnetic with Curie temperature above room temperature. Both of Co-doped nanoclusters show positive magnetoresistance (PMR) at low temperature, but the amplitude of the PMRs shows an anomalous difference. For similar Co doping concentration at 5 K, PMR is greater than 800% for Co-doped ZnO but only 5% for Co-doped Cu_2O nanoclusters. Giant PMR in Co-doped ZnO which is attributed to large Zeeman splitting effect has a linear dependence on applied magnetic field with very high sensitivity, which makes it convenient for the future spintronics applications. The small PMR in Co-doped Cu_2O is related to its vanishing density of states at Fermi level. Undoped Zn/ZnO core-shell nanoparticle gives high ferromagnetic properties above room temperature due to the defect induced magnetization at the interface.

[1]Research work is supported by DOE-BES and DOE-EPSCoR in USA.

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Date submitted: 30 Aug 2010 Electronic form version 1.4