Spintronics nanomaterials for future computer - investigation of ferromagnetic semiconductor and giant positive magneto-resistance

By

Prof. You Qiang

University of Idaho, Moscow, Idaho 83844-0903, USA

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Host: Asst. Prof. Tom Wu

Abstract:

Much interest has been sparked by the discovery of ferromagnetism in a range of oxide semiconductors doped with a few percent of transition metal (TM) cations. The development of ferromagnetic oxide semiconductor materials with giant magneto-resistance (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 Cu₂O 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 Cu₂O 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 Cu₂O is related to its vanishing density of states at Fermi level. Research work is supported by DOE-BES and DOE-EPSCoR in USA.

Biography:

Prof. Qiang has studied magnetic nanoparticles and nanocomposites for more than 20 years. His expertise includes: synthesis of monodispersive nanoclusters and nanocluster-assembled composites; and characterization of magnetic and optical properties as well as transports of the nanomaterials by conductivity, optic and susceptibility. He applied magnetic nanoclusters in environmental and biomedical science and technology.