497th ASRC Seminar

Date: 13:30 - 15:00, 7th January

Location: Meeting room 103, ASRC Building

Speaker: Prof. Yasutomo Uemura

(Columbia University, U.S.A.)

Title: Diluted Ferromagnetic Semiconductors (Ga,Mn)As, Li(Zn,Mn)As,(Ba,K)$(Zn,Mn)_2As_2$: Materials development, MuSR, and future

In the mid 1990's Hideo Ohno and co-workers succeeded in substituting Mn into Ga site of a semiconductor GaAs by using Molecular Beam Epitaxy (MBE), opening a field of diluted magnetic semiconductors (DMS). Since then, ferromagnetic (Ga,Mn)As has been extensively studied with respect to possible applications to spin sensitive electronics (spintronics) devices. Substitution of Mn^2 and Ga^3, however, led to limitations as (a) very small chemical solubility limit which prohibits availability of bulk specimens; and (b) simultaneous spin and charge doping leading only to p-type systems. Following theoretical proposal of Jungwirth, collaboration of the group of Chanqing Jin at IOP Beijing and the present speaker has succeeded in overcoming these difficulties by synthesizing new DMS systems Li(Zn,Mn)As ([1] ferromagnetic Tc up to 50 K) and (Ba,K)$(Zn,Mn)_2As_2$ ([2] Tc up to ~ 200 K). These systems have similar/identical crystal structures with those of FeAs superconductors LiFeAs and (Ba,K)Fe_2As_2, with a very good matching of lattice parameters. Bulk specimens of these new DMS systms have already enabled NMR and neutron measurements, while future developments may allow production of n-type ferromagnets, bipolar transistors, and multilayer/interface junctions of various combinations of lattice-matched semiconductor, ferromagnet, antiferromagnet and superconductor.
In this talk, I will review materials developments and our MuSR studies on these traditional [3] and novel [1,2] DMS systems.

[1] D. Zheng et al. Nature Communications, 2:422 (2011) [2] K. Zhao et al., Nacure Communications, accepted for publication.
[3] S.R. Dunsiger et al., Nature Materials, 9, 299-303 (2010).

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