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Nano/Microstructures of Some DMS Materials Fabricated by High Magnetic Field-hydrothermal Synthesis

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Abstract
It is well known that the size and morphology of diluted magnetic semiconductors influence the properties definitively. Various methods have been used to obtain many kinds of morphologies. It is the first try to fabricate the nano/micro particles of Mn, Cr, Co-doped ZnO by hydrothermal method under high pulsed magnetic field. Characterizations were carried by X-ray diffraction (XRD) and scanning electron microscopy (SEM) at room temperature. Their microstructure and morphology are quite different with that obtained by no field-hydrothermal method in the same reaction conditions. It will be reported in this presentation.

AT20

Anisotropy Magnetic Properties of Vertically Epitaxial Grown Mn Doped Ge Nanowires

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The concept of simultaneously manipulating both charge and spin in a single semiconductor medium leads to the exciting area of spintronics. Semiconductors doped with transition metal, so called diluted magnetic semiconductors (DMSs), are the most promising candidates for such applications [1]. Recently, many studies have been reported room temperature (RT) ferromagnetism from transition metal doped semiconductors in thin film and nanowire systems. Among these, the nanowire system showed the excellent magnetic properties and especially has a number of advantages of studying the origin of RT ferromagnetism due to its single crystalline nature and defects free. In here, two essential points, RT ferromagnetism and magnetic anisotropy, are important to realize the spin-based transistor proposed by Datta and Das [2]. Many studies have recently reported the magnetic anisotropy from transition metal doped semiconductors, especially Mn doped GaAs-based thin film systems [3]. However, these materials have not shown the RT ferromagnetism. There has been not studied magnetic anisotropy in nanowire systems yet because it has trouble in studying magnetic anisotropy for using the nanowire system. For the measurement of magnectic anisotropy nanowires is necessary to be controlled on alignment along only one direction, especially preferred to align vertically to the substrate surface. Here we present the magnetic anisotropy of Mn:Ge nanowires grown on Ge(111) substrates vertically. We successfully synthesized the vertical Mn:Ge nanaowires using a Au catalyst deposited Ge substrates in a germanium tetrachloride ($GeCl_4$)-based chemical vapor transport system. For doping, MnCl2 (purity 99.99%) powder is used as a doping source. The typical diameter and length of the Mn:Ge nanowires are from 60 nm to 80 nm and 5 micrometers, respectively. In previous studies, we have studied the DMS system of Mn doped Ge nanowires and reported RT ferromagnetism from this system grown on Si substrates. Mn doped Ge nanowires showed p-type electrical characteristic, RT ferromagnetism, and the possibility of device fabrication through hysteresis. For further study on the possibility of their full potential for practical DMS-based spin devices, we present the anisotropy magnetic properties in this system through the angle-dependent XMCD and SQUID measurements using vertically grown Ge.

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