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Magnetic domain structure study of a ferromagnetic semiconductor using a home-made low temperature scanning Hall probe microscope[1]

SEONGSOO KWEON, Materials Science and Engineering, ALEX DE LOZANNE, Department of Physics, U Texas at Austin, NITIN SAMARTH, Physics Department, Penn State U,University Park, PA — GaMnAs is a ferromagnetic semiconductor actively studied for basic research and for the possibility of application to spintronic devices. To study the local magnetic properties of this material the magnetic force microscope (MFM) is too invasive (by affecting the domains in the sample) or not sensitive enough (due to the weak magnetization of the GaMnAs). We have therefore built a scanning Hall probe microscope (SHPM) to complement our MFM studies. We use a lock-in amplifier to supply a bias current of 1-10μA and to measure the Hall voltage. We calibrated this home-made SHPM with a computer hard disk sample. Comparing images of this sample obtained with MFM and SHPM we show that our home-made SHPM is operating well. We observed the domain structure of 30-nm thick $Ga_{0.94}Mn_{0.06}As$ epilayer grown on a 700nm-thick $In_{0.13}Ga_{0.87}As$ buffer covering a GaAs substrate. We will study the magnetic domain structure as a function of temperature with varying external magnetic fields.

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