Abstract Submitted
for the MAR07 Meeting of
The American Physical Society

Sorting Category: 06.4 (E)

Non-equilibrium Fe-Si thin films as potential spin injection materials JIAN ZHOU, ERIK HELGREN, University of California at Berkeley, LI ZENG, UCSD, FRANCES HELLMAN, University of California at Berkeley — Fe-Si thin films are potential spintronics materials for its tunable structural, magnetic, and electric properties [1]. Our goal is to inject spin polarized electrons from iron-silicides into Si through a Schottky barrier, which is formed by choosing the proper doping level for Si, and a suitable Iron-silicide composition. We prepared $Fe_{1-x}Si_x$ (x = 0.25 - 0.5) films by electron beam co-evaporation from Fe and Si sources onto Si substrates under ultra-high vacuum conditions. Growth at 300 $^\circ$C leads to a homogeneous $Fe_{1-x}Si_x$ magnetic alloy with both Tc and room temperature magnetization monotonically decrease with an increasing x. X-ray diffraction patterns show that a thin seed layer of FeSi at interface reduces the lattice mismatch between Si substrate and the bcc $Fe_{1-x}Si_x$ film, so that epitaxial growth can be realized. The seed layer also plays the role of reducing interdiffusion. A clear interface at Iron-silicide and silicon is obtained, resulting in a good Schottky barrier with height around 0.7 eV. By adjusting the $Fe_{1-x}Si_x$ composition, the resistivity of iron-silicide can be tailored. Ferromagnetic $Fe_{55}Si_{45}$ shows resistivity of 10^{-3} ohm-cm, and magnetization 100 emu/cc at 300 K. By increasing the iron-silicide resistivity, one of the main obstacles for spin-injection from metal to semiconductor – the resistivity mismatch – can be overcome. Experiments based on spin-valve-type magneto-resistance for spin injection detection will be discussed. [1]. Ionescu et al. Physical Review B 71, 94401 (2005).

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[X] Prefer Oral Session
[ ] Prefer Poster Session

Date submitted: 20 Nov 2006 Electronic form version 1.4