Structural and Magnetic Properties of FeSi Films Grown on Si(001)

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Since the discovery of skyrmion lattice formation in $Fe_{0.8}Co_{0.2}Si$, the growth of Fe(Co)Si thin films has attracted much interests during the last several years. The high reactivity between 3d transition metal Fe and Si produces a number of stable phases (Fe_3Si, ε-FeSi, α-$FeSi_2$, β-$FeSi_2$) and metastable silicides (c-FeSi, γ-$FeSi_2$). The semiconducting β-$FeSi_2$ has attracted much attention for optoelectronic devices because of its band gap of 0.9 eV, corresponding to the adsorption minimum of silica optical fiber[1]. Ultrathin ferromagnetic Fe_3Si films has been used as a spin injector in spin devices.[2] The stable ε-FeSi is a paramagnetic narrow band gap (0.05 eV) semiconductor. Berling *et al.* reported that the Fe magnetic moment depends in the chemical composition of iron silicides and that the Fe magnetic moment decreases from ~2.2 μ_B (bulk Fe) to 0 (FeSi) with increasing the Si concentration[3]. Here we report on the modified magnetism from paramagnetic to ferromagnetic states in ε-FeSi thin films. Firstly, we grew Fe thin films on Si(100) substrates at 30 and 600 °C using MBE. Interestingly, the crystal structure was changed to ε-FeSi for the samples grown at 600 °C. The temperature dependent resistivity changed from metallic to semiconducting with growth temperatures. In order to investigate the correlation between magnetization and charge carrier transport, we performed magnetoresistance and Hall resistance measurements. The saturated magnetization and coercive field of the samples grown at 30 and 600 °C are 1129 emu/cm^3; 86 Oe and 4.6 emu/cm^3; 29 Oe at 300 K, respectively.

참고문헌

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