Influence of segregation of divalent europium on magnetic and transport properties of MBE grown Eu-Fe thin films

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Due to potential ability of controlling the Eu valency and consequently switching between non-magnetic (Eu³⁺) and magnetic (Eu²⁺) states we examined the electronic structure as well as magnetic and transport properties of MBE grown Eu-Fe thin films. We considered that such Eu-based materials, in which the control of the valency of Eu would be possible, may be applied into new classes of spin-based sensor, memory or logic devices.

20-30 nm thick Eu-Fe films were grown on Si or GaAs (with a 50 nm thick buffer layer of Mo) in two different deposition modes — multilayer deposition and co-deposition [1]. The changes associated to the reaction with surrounding transition metal (monitored via Reflection High Energy Electron Diffraction and X-ray Photoemission Spectroscopy) lead to valency transition of europium Eu²⁺ ↔ Eu³⁺. Ferromagnetic behavior of the Eu-Fe films up to the highest available temperature of 400 K and strong thermomagnetic effects, were observed via SQUID. The XPEEM images (X-ray Photoemission Electron Microscopy) indicate segregation of the divalent europium for selected films. Additionally observed anomalies in temperature dependence of electrical resistivity, obtained from 4-point probe measurements, may indicate frustration in magnetic ordering.

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References