Galfenol Thin Films Deposited by MBE

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Abstract Body: Single crystal Galfenol ($Fe_{1-x}Ga_x$) thin films (10-12 nm) of various Ga concentrations (x=0-.25) were prepared on GaAs(100) and GaAs(110) substrates, with and without ZnSe buffer layers, by molecular beam epitaxy (MBE). Galfenol is a technologically relevant material with uses in sensors, actuators, and multifunctional devices. Reflection high energy electron diffraction (RHEED) measurements, performed *in situ* to monitor crystal quality, showed epitaxial growth. Magnetic anisotropy constants were determined using magneto-optic Kerr effect (MOKE), vibrating sample magnetometry (VSM), and angle-dependent ferromagnetic resonance. The extracted anisotropy values further confirm the crystallinity of the Galfenol films, and are compared to pure Fe and the magnetoelastic constants of bulk Galfenol. The thicknesses of the films were obtained from Rutherford backscattering (RBS) data, and the Ga concentrations were determined using X-ray fluorescence. X-ray absorption spectroscopy (XAS) and X-ray magnetic circular dichroism (XMCD) performed at the Fe $L_{2,3}$-edges reveals the metallic nature and the spin and orbital contributions to the magnetic moment of the iron. XMCD of the Ga $L_{2,3}$-edges was used to determine the magnetic moment induced in the gallium as a function of Ga concentration.

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