

Magnetostructural Transitions in FeRh Films

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Magnetostructural materials exhibit simultaneous magnetic and structural phase changes of an abrupt and hysteretic nature that attest to the extremely strong coupling between the lattice and the magnetic spin in these systems. As these transitions can be quite sensitive to strain, it is anticipated that thin films of such materials are a rich arena in which to explore these phenomena. To this end, we report here results obtained from high quality, epitaxial nominally-equiatomical FeRh thin films grown via MBE on MgO(001) substrates. Depth-dependent x-ray diffraction (XRD) was augmented by x-ray magnetic circular dichroism (XMCD), conducted at the L_{2,3} edges of Fe, performed as a function of temperature to investigate the magnetostructural transition in thin films of nominally-equiatomical FeRh.

Upon heating from room temperature to 420 K, the FeRh antiferromagnetic (AF)-ferromagnetic (F) transition was investigated in films of 500 Å and 1000 Å thicknesses capped by a 20 Å Au layer. As verified by *ex-situ* magnetometry, the transition temperatures of these films are 385 K and 375 K under a 0.01 T field, with a thermal hysteresis of 10 degrees. The temperature-dependent XRD data confirm that the magnetic transition throughout the film is accompanied by a quasi-uniform 5% contraction in (001) direction normal to the film plane, while the in-plane lattice parameters show no variation with film depth (Fig. 1). Minimal thermal hysteresis was observed in the XRD data. The XMCD data echo the expected AF – F transition, but also indicate a decrease in the peak energy of the L_{2,3} Fe edges with increasing temperature through the transition, suggesting a continuous change in the nature of the band structure upon transition to the ferromagnetic state (Fig. 1).

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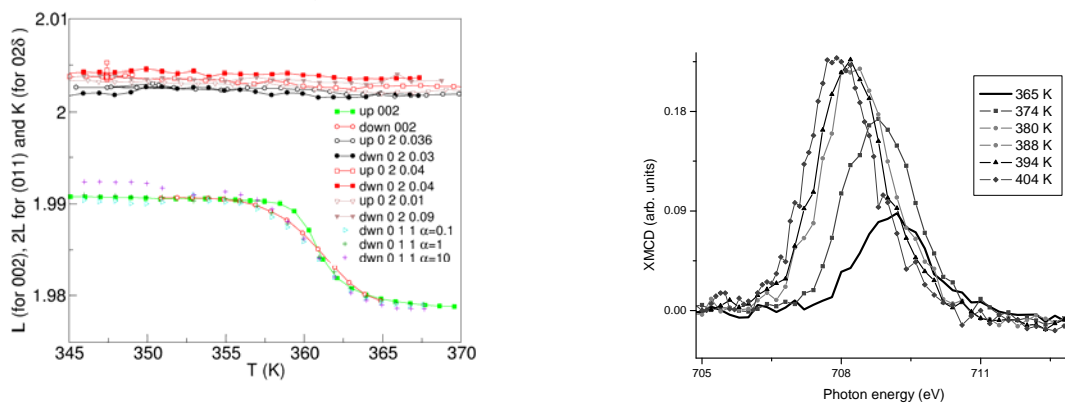


Figure 1: Temperature dependence of lattice parameters (left) and close-up of the Fe L₃ edge XMCD (right) from a 500 Å FeRh film.