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Lattice dynamics of ultrathin EuO films and interfaces

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Europium monoxide (EuO) is the first rare-earth semiconducting oxide known for its giant magneto-optic Kerr [1] and Faraday [2] effects, metal-insulator transition [3] and anomalous Hall effect [4]. Presently, it is one of the favored candidates for applications as a spin filter in future spintronic devices due to the large exchange splitting of its conduction band [5]. Employing inelastic X-ray scattering, nuclear inelastic scattering and first-principles theory we determined the lattice dynamics of this material and discovered a giant and anisotropic spin-phonon coupling [6]. This imposed the intriguing question about the manifestation of this phenomenon in thin and ultrathin films related to the proposed applications. Using in situ nuclear inelastic scattering on 151Eu we investigated the phonon density of states of EuO films with thickness between 8 nm and of 1 atomic layer. The experimental results unveiled drastic lattice dynamics modifications in the ultrathin EuO films that can be comprehensively understood by the help of first-principles theory.

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