

## Enhanced Magnetization of $\text{CuCr}_2\text{O}_4$ Thin Films by Substrate-Induced Strain

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**Abstract Body:** Magnetic spinel oxides are currently the subject of intense research due to their potential in spin-based devices. We report the first synthesis of epitaxial ferrimagnetic  $\text{CuCr}_2\text{O}_4$  thin films which show an enhanced magnetic moment up to 200% greater than bulk and have the potential to exhibit increased spin filtering effects as a barrier layer in magnetic tunnel junction structures.  $\text{CuCr}_2\text{O}_4$  is an electrically insulating, magnetic oxide with a tetragonally distorted normal spinel crystal structure. X-ray diffraction studies of  $\text{CuCr}_2\text{O}_4$  films grown by pulsed laser deposition on (110) and (100)  $\text{MgAl}_2\text{O}_4$  substrates confirm that they are single-phase with a significant out of plane epitaxial compressive strain of 4.4%. A combination of Rutherford backscattering spectroscopy, x-ray absorption spectroscopy, and resonant x-ray scattering were used to confirm stoichiometric normal spinel  $\text{CuCr}_2\text{O}_4$  films with bulk-like cation valence states. Yafet and Kittel [1] proposed that the magnetic moments of the one  $\text{Cu}^{2+}$  and two  $\text{Cr}^{3+}$  cations in bulk  $\text{CuCr}_2\text{O}_4$  are arranged in a frustrated triangular configuration, resulting in a low bulk moment of  $0.5\mu_B$  per formula unit [2,3]. The low bulk moment is related to the Jahn-Teller activity in tetrahedral  $\text{Cu}^{2+}$ , which introduces tetragonality to the spinel structure. While our magnetism studies find that  $\text{CuCr}_2\text{O}_4$  thin films have a  $T_C$  of 114K similar to the bulk  $T_C$  of 135K, the overall moment of our thin films exceeds that of the bulk. A 50 nm film has a magnetic moment of  $1.6\mu_B$  per formula unit. We believe the origin of the enhanced moments to be the reduction in tetragonal distortion due to epitaxy on the cubic spinel  $\text{MgAl}_2\text{O}_4$  substrates. Tuning of the magnetics via heteroepitaxy can also be applied more generally to other complex magnetic oxide materials.

**References:** [1] Y.Yafet et al., Phys. Rev. 87, (1952) 290.

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