Magnetic Spinel Ferrite Thin Films and Heterostructures

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There is considerable interest in the growth of high quality, single crystal spinel ferrites films because of their numerous technological applications in areas such as microwave integrated devices, magnetoelectric coupling heterostructures, spin Seebeck effect, and potentially as an active barrier material in an emerging class of spintronic devices called spin filters. Unlike perovskites, the study of spinel ferrite films is quite limited in part because of the complex crystal structure with a large unit cell consisting of many interstitial sites and that the transition metal cations can adopt various oxidation states. We have grown high-quality, atomically smooth epitaxial ferrite films using pulsed laser deposition and chemical vapor deposition techniques, and carried out detailed studies of the structural, magnetic and optical properties of the films. Of particular interest are systematic studies on formation of antiphase boundaries in epitaxial ferrite films grown on different substrates and the accurate determination of the band gap of $NiFe_2O_4$ and $CoFe_2O_4$ using optical spectroscopy and first principles calculations. Additionally, we have grown ferrite films on piezoelectric substrates and observed large shifts in the ferromagnetic resonance profile due to strong magnetoelectric coupling resulting from electrostatic field-induced changes in the magnetic anisotropy field.

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