AIP Journal of Applied Physics

Published Online: 26 June 2019

Accepted: June 2019

Temperature dependent resonant microwave absorption in perpendicular magnetic anisotropy epitaxial films of a spinel ferrite

Journal of Applied Physics **125**, 243903 (2019); https://doi.org/10.1063/1.5099149

R. C. Budhani[1,a)], Sergey A. Basun[2,3], Michael E. McConney[2], Dean R. Evans[2], Michael R. Page[2], *and* Brandon M. Howe[2]

Hide Affiliations

[1]Department of Physics, Morgan State University, Baltimore, Maryland 21251, USA
[2]Air Force Research Laboratory, Materials and Manufacturing Directorate, Wright-Patterson Air Force Base, Ohio 45433, USA
[3]Azimuth Corporation, 4027 Colonel Glenn Highway, Suite 230, Beavercreek, Ohio 45431, USA
[a)]**Author to whom correspondence should be addressed:** Ramesh.budhani@morgan.edu

ABSTRACT

We report on the temperature (T), magnetic field ($\mu_0 H$), and angle (Θ, Φ) dependent resonant absorption of X-band microwaves in spinel ferrite epitaxial films subjected to two distinct states of growth strain. The polar angle (Θ) dependence of the resonance field (H_{res}) in films with ~0.5% *ab*-plane expanded unit cell establishes a distinct perpendicular magnetic anisotropy (PMA). The anisotropy field ($H_{an}^{\perp}$) for Θ = 0° increases monotonically on lowering the temperature from 300 K to 90 K following the behavior of the saturation magnetization (M_s) keeping $H_{an}^{\perp}/M_s \approx 1$. The narrow resonance linewidth ($\mu_0 \Delta H_{res}^{\perp}$ = 3.7 mT at 300 K) and its negligible (±0.3 mT) variation with temperature establish the magnetic softness of these PMA films. The dependence of H_{res} on Θ, Φ, and T in films subjected to compressive stress shows in-plane cubic anisotropy whose strength is nonmonotonic in temperature. The ~2.0% compression of the unit cell basal plane also appears to accentuate noncollinearity of sublattice magnetization of such films as indicated by the T-dependence of ΔH_{res}. The

PDF | CHORUS

determination of the spin wave stiffness constant together with independent determination of $H_{an}^{\perp}$. The resonance characteristics of the PMA films qualify them as potential candidates for frequency agile microwave devices and magnonic circuit elements.

ACKNOWLEDGMENTS

This material is based upon work supported by the Air Force Office of Scientific Research under Award No. FA9550-15RXCOR198. R.C.B. acknowledges the National Research Council, Washington DC, for the award of a senior fellowship. Partial support has also come from the Office of Naval Research under Award No. DOD-078-24086 at Morgan State University.