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

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R. C. Budhani^{1,a)}, Sergey A. Basun^{2,3}, Michael E. McConney²,  Dean R. Evans²,  Michael R. Page², and Brandon M. Howe²

Hide Affiliations

¹Department of Physics, Morgan State University, Baltimore, Maryland 21251, USA

²Air Force Research Laboratory, Materials and Manufacturing Directorate, Wright-Patterson Air Force Base, Ohio 45433, USA

³Azimuth 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 $\sim 0.5\%$ *ab*-plane expanded unit cell establishes a distinct perpendicular magnetic anisotropy (PMA). The anisotropy field ($H_{an}^\perp$) for $\Theta = 0^\circ$ 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 $\sim 2.0\%$ 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



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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.

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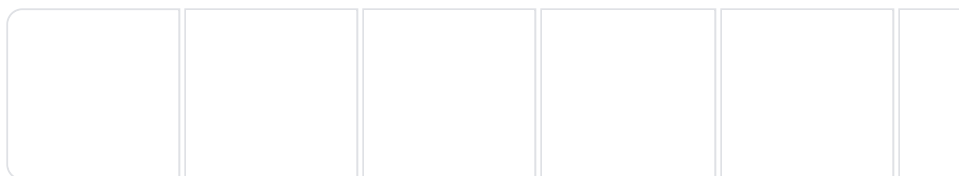
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