2019 MMM Conference

View Abstract

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CURRENT SUB-CATEGORY: a. Magnetization Dynamics and Damping

TITLE: Narrow Total Linewidths in Low-Damping Epitaxial $Fe_{1-x}V_x$ Thin Films

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ABSTRACT BODY:

Abstract Body: To induce spin-torque precession of the magnetization with low threshold current densities, it is desirable to have ferromagnetic metals that possess low damping (narrow resonance linewidths) and low saturation magnetization. A commonly used material in spintronic devices, Fe, already has low Gilbert damping but high saturation magnetization. Alloying Fe with Co [1] allows the damping to decrease to record low values in metallic films but further increases the saturation magnetization. Previous theoretical [2] and experimental studies [3-5] have suggested that alloying Fe with V decreases both damping and saturation magnetization although realization of narrow total linewidths has remained elusive.

In this study, we have grown high-quality epitaxial $Fe_{1-x}V_x$ thin films with narrow linewidths by cosputtering on MgO and $MgAl_2O_4$ substrates. The Gilbert damping parameter α and saturation magnetization M_{sat} for each sample are quantified using broadband ferromagnetic resonance (FMR) and vibrating sample magnometry, respectively. In contrast to prior experiments [5] that showed broad FMR linewidths (e.g. $\Delta H_{pp} \approx 40$ Oe at f = 17 GHz) , our samples show significantly narrower total linewidths (e.g. $\Delta H_{pp} \approx 22$ Oe at f = 17 GHz, see Fig. 1). This reduction in linewidth is achieved by annealing the substrates at elevated temperatures prior to deposition, allowing for higher quality films and enabling the combination of low Gilbert damping and low inhomogeneous linewidth broadening ΔH_0, as shown in Fig. 2. Compared to epitaxial Fe samples deposited under similar conditions, we see a reduction in the Gilbert damping by as much as ≈20% for $Fe_{80}V_{20}$. We also observe reduction in the saturation magnetization by ≈20% for $Fe_{80}V_{20}$ when compared to pure Fe. Our findings point to FeV as an attractive ferromagnetic alloy for energy-efficient spintronic devices.

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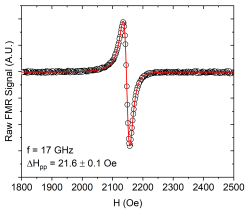

Figure 1: Exemplary FMR signal of $MgO/Fe_{90}V_{10}$ thin film at f = 17 GHz.

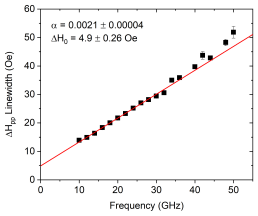

Figure 2: Linewidth vs. frequency plot for $MgO/Fe_{90}V_{10}$. The values of the Gilbert damping parameter and zero frequency linewidth are extracted from the linear fit.

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Attendance at Conference: I acknowledge that I have read the above statement regarding the requirement that an author of this presentation must attend the conference to present the paper.

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