Supplemental Material

Development of $L1_0$-ordered FePt with low damping and large perpendicular magnetic anisotropy by engineering the nanostructure

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Supplementary Note 1

A comparison of $L1_0$-ordered FePt grown on MgO(001) and SrTiO$_3$ (STO) single crystalline substrates which have similar frequency and perpendicular magnetic anisotropy (PMA). The FePt/STO sample shows a smaller intrinsic and effective damping α and α_{eff} compared to the FePt/MgO sample despite both samples having a similar PMA. Since both materials have a similar PMA, this suggests that it is important to control other mechanisms such as the number of misfit dislocations, and the nanostructure, to optimize the damping in FePt and other magnetic materials.
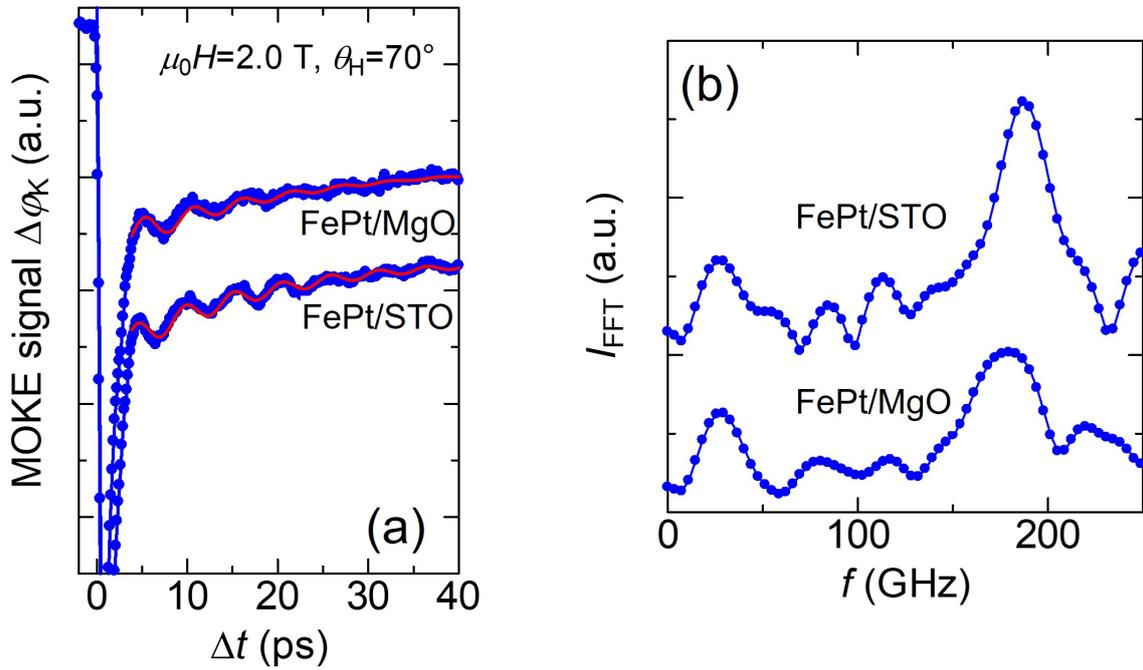

FIG. S1. (a) Comparison of the raw TRMOKE spectra (blue dot) and fitting (solid red line) for a FePt/STO and FePt/MgO sample with similar PMA at the same applied field $\mu_0 H = 2.0$ T and magnetic field angle $\theta_{\mathrm{H}} = 70°$, and (b) the fast Fourier transform (FFT) of these spectra where the frequency for both samples is centered around $170 - 180$ GHz.
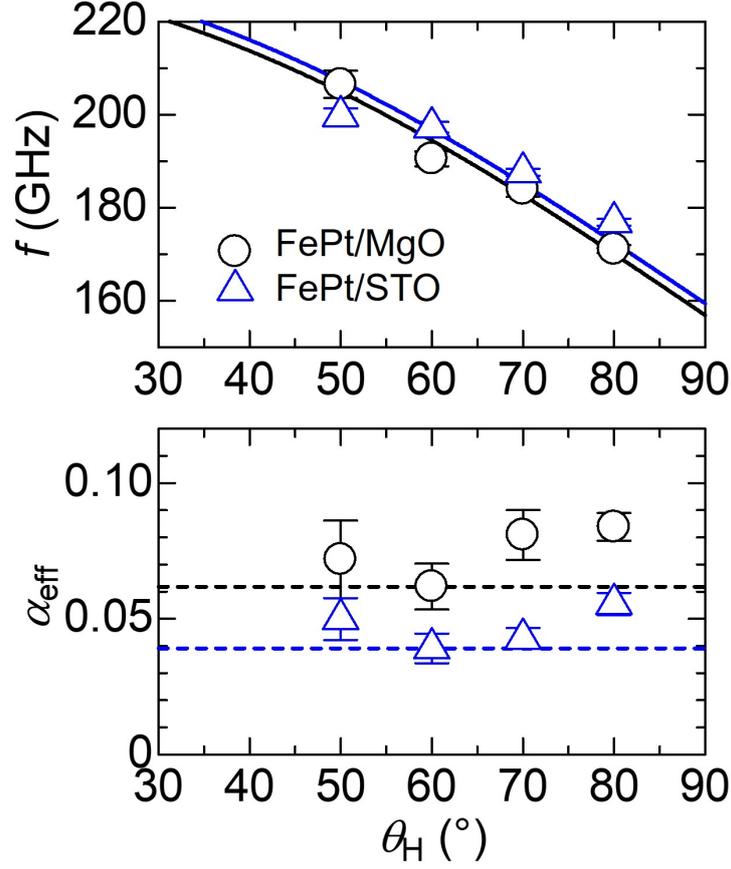
FIG. S2. Frequency f and effective damping α_{eff} as a function of magnetic field angle θ_{H} for $L1_0$-ordered FePt grown on MgO and STO. The solid points are experimental results, solid curve fitting using the Landau-Lifshitz-Gilbert equation, and the dotted line indicating the minimum α_{eff} which for the FePt/STO and FePt/MgO sample is ≈ 0.039 and 0.062, respectively.