# Enhanced effective damping constant in Mn based nitride compounds

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Mn based nitrides such as $Mn_4N$ has been recently focused due to its ferrimagnetism, low $M_s$ (~100 emu/cm$^3$), high perpendicular magnetic anisotropy (PMA) ($K_u$ ~ 1Merg/cm$^3$).[1] Furthermore, such the values can be widely modulated by embedded transition metals.[2] However, effective damping constant ($\alpha_{eff}$) have not been evaluated while $\alpha_{eff}$ could give an insight into spin device engineering. In this study, $\alpha_{eff}$ for the FeMnN films with various Mn content were compared, and discussed the mechanisms involved.

30-nm-thick $Fe_{4-x}Mn_xN$ ($x$ = 0, 1, 2, and 4) pseudo single-crystal films were grown on MgO(001) substrates by molecular beam epitaxy. Out-of-plane magnetic properties were investigated by measuring transverse resistivity ($\rho_{xy}$) of the films (Fig. 1a). $a_{eff}$ was estimated both from the linewidth of microwave absorption spectra and the oscillation frequency of time-resolved magneto optical Kerr signals. All the measurements were performed at room temperature.

Figure 1(a) shows the out-of-plane magnetic field dependence of $\rho_{xy}$. It was revealed that magnetization easy-axis corresponds to in-plane for the $x$ = 0, 1 and 2, while out-of-plane for $x$ = 4, indicating that perpendicular magnetic anisotropy was enhanced with increasing Mn content. Figure 1(b) shows the $x$ dependence of $\alpha_{eff}$. The $\alpha_{eff}$ ~ 0.03 was obtained for the $x$ = 0 ($Fe_4N$), which agreed with the previous value.[3] The $\alpha_{eff}$ decreased down to 0.01 for the $x$ = 1, then monotonic increase was observed up to the $x$ = 4. Possible mechanisms will be discussed at the conference, but note that $\alpha_{eff}$ ~ 0.15 for the $x$ = 4 was two orders of magnitude higher compared with the other Mn based metallic alloy systems such as MnGa.[4] These results suggest that $Mn_4N$ might be one of the material candidates for spin injection layers in mag-flip spin torque oscillators[5] and/or reference layers in magnetic tunnel junctions with PMA.

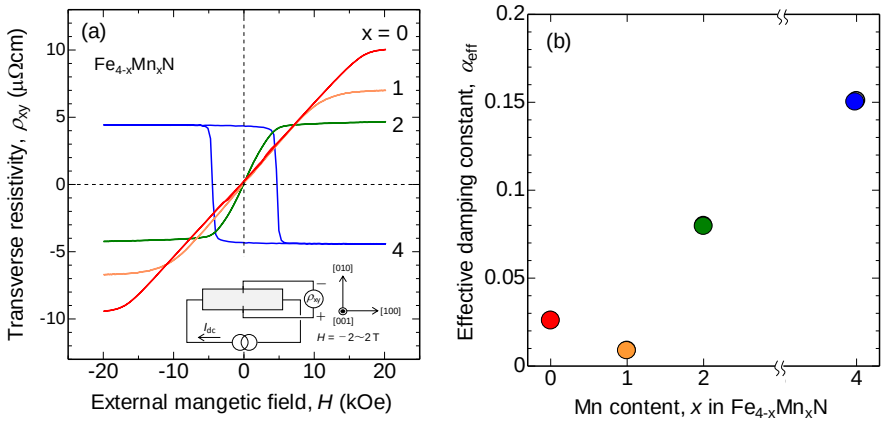


**Fig. 1** (a) Out-of-plane magnetization curves of FeMnN films. (b) Effective damping constant ($\alpha_{eff}$) measured using ESR and TR-MOKE (pump-probe method).

References:
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