Magnetization relaxation in $(CoFe)_{1-x}Ge_x$ alloys

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The short spin-diffusion length and high bulk spin-scattering parameter of $(CoFe)_{1-x}Ge_x$ alloys [1] makes them interesting candidates for future high-density recording read-head sensors. Here we report on the magnetization relaxation and structural properties of Ta(5 nm)/Cu(4 nm)/$(CoFe)_{1-x}Ge_x$(10, 50 nm)/Ru(7nm) films in the composition range 0 at. %<=x<= 35 at.%. For films in the concentration range 10 at.%<x< 33 at.% annealed at 245°C we find B2 ordering and for concentrations above 39% a hexagonally closed packed (hcp) structure. In the composition range in between we find a bcc+hcp phase mixture. These results correlate with the effective damping parameter measured in these alloys, where we find a broad miniumum with $\alpha \approx 0.0025$ for Ge concentrations from 20-30%, with a minimum in the relaxation rate G=33 MHz for a Ge concentration of 30 at.%. A strong increase of the damping is measured for the thick GoFeGe films with Ge concentrations above 33 at. %. For 10nm thick films and in full spin-valve structures we find evidence for a significant contribution to the magnetization relaxation caused by two magnon scattering. Temperature dependent FMR measurements (10 K-RT) were carried out for a 50nm thick $(CoFe)_{1-x}Ge_x$ film with x=30%, i.e. the film with the lowest relaxation rate at room temperature. Here we observe a shallow minimum in the linewidth around 60-70K First principles calculations carried out for B2 ordered $(CoFe)_{75}Ge_{25}$ structures show a pseudogap in the minority channel, consistent with the low magnetic damping [2,3] and the high CPP-GMR signal observed in spin-valves using these alloys in previous studies [1].

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References:

[1]: S. Maat, M.J. Carey, and J.R. Childress, Appl. Phys. Lett. **93**, 143505 (2008).
[2]: C. Liu, C.K.A. Mewes, M. Chshiev, T. Mewes, W.H. Butler, Appl. Phys. Lett. **95**, 022509 (2009).
[3]: H.Lee, Y.-H. A. Wang, C.K.A. Mewes, W.H. Butler, T. Mewes, S. Maat, B. York, M.J. Carey, J.R. Childress, Appl. Phys. Lett. **95**, 082502 (2009).

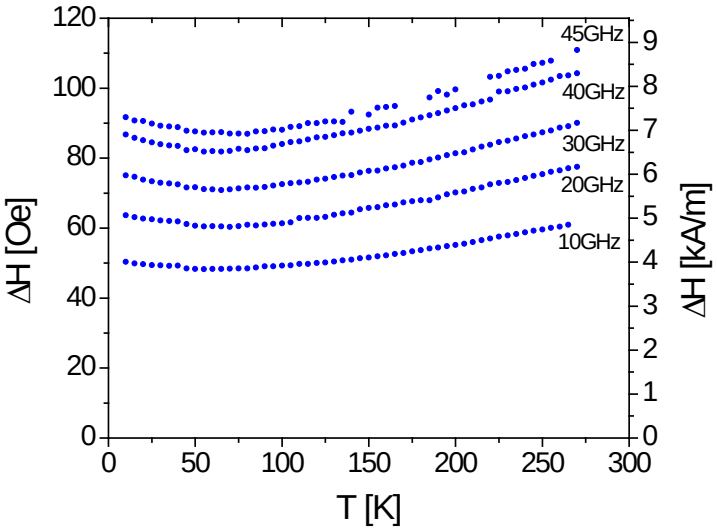

Fig. 1: Temperature dependent FMR linewidth of a $(CoFe)_{1-x}Ge_x$ film with x=30%, measured at 10, 20, 30, 40 and 45 GHz.