Driving skyrmions with high mobility in synthetic ferrimagnets

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Being at the same time, a direct signature of the topological nature of magnetic skyrmions and an issue for their implementation in renewed logic and memory devices, the so called skyrmion Hall effect (SkHE) has been the focus of many researches in the last few years [1]. In this context, investigation of ferrimagnetic systems in which two sublattices with opposing spin orientations can compensate each other to achieve behaviour similar to that of an antiferromagnet, are of interest thanks to the additional flexibility of tuning the properties by varying temperature, the individually detectable proportion of the constituting materials, etc. In this context, we focus on multilayers of Pt/Co/Tb by controlling the thickness of Co and Tb, as well as the numbers of repetition to obtain a signature of antiferromagnetic coupling between the Co and Tb moments. The comparison of skyrmion velocity in Co-Tb multilayers with different Tb thicknesses is shown in Fig. 1(a). We observed a significant enhancement of skyrmion velocity and decrease in the net magnetization as the Tb thickness is increased. In the best samples, we obtained velocity up-to ~400 m/s for skyrmions with diameter of 160 nm. The correlation between field-induced domain wall (DW) motion and current induced skyrmion motion with prediction of DW creep, depinning, and flow is demonstrated in Fig. 1(b). In conclusion, we show that with the control of ferrimagnetic ordering in Co-Tb multilayers by varying the Tb thicknesses, we can achieve high skyrmion mobility in *DW flow* regime with reduced SkHE. We acknowledge French ANR grant TOPSKY (ANR-17-CE24-0025), DARPA TEE program grant (MIPR#HR0011831554), FLAG-ERA Sograph MEM (ANR-15-GRFL-0005), for their financial support.

References

[1] A. Fert *et al*, Nat. Rev. Mat. 2 (2017) 17031

Figures

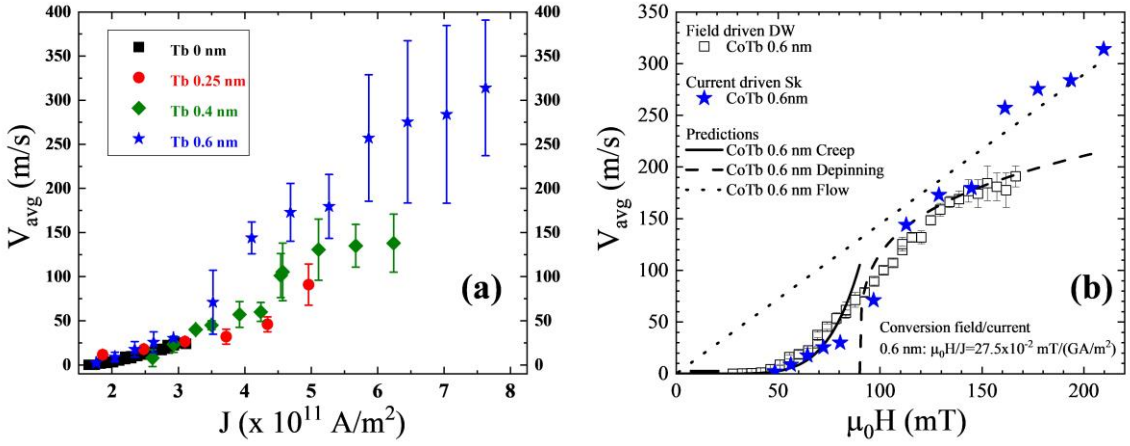

Figure 1: (a) Comparison of skyrmion velocity in Co-Tb multilayers with different Tb thicknesses. (b) Correlation between field-induced DW motion and current induced skyrmion motion with prediction of DW creep, depinning, and flow.