Engineering spin-orbit torques for efficient skyrmions dynamics

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Magnetic skyrmions have been identified as extremely promising candidates for future spintronic applications and for fundamental interest [1]. In order to improve skyrmion dynamics via spin-orbit torques (SOT), numerous efforts have been made in recent years albeit with a restricted velocity due to pining and edge effect. In this study, we investigate the role of light element interface on the SOTs to improve the skyrmion dynamics in Co/Pt-based magnetic multilayers [2]. First, we quantify the amplitude of the damping-like and field-like SOT components in Pt|Co|X based multilayers, with X= Al, Ir, Pt and Cu (Fig.1a). We observe significant increase of the damping-like torque with Al due to formation of Rashba like interface. The direct consequence of the enhanced torques can be observed in the skyrmion motion in the Pt|Co|Al based skyrmionics heterostructures (Fig.1b) where the mobility increases by a factor four. Then, we investigate the behaviour of the skyrmions in different tracks using MOKE microscopy where we observe a cancellation of the skyrmion Hall angle especially at the edges of the tracks. We also underline their strong resilience to potential defects, for eg. their tendency of avoiding the notches along the edges during their motion. We further observe that the skyrmions are guided along the domains inside track due to repulsion from the DWs. Ultimately, we observe that there is a change in skyrmion velocity as a function of position in rounded geometries.

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References

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Figures

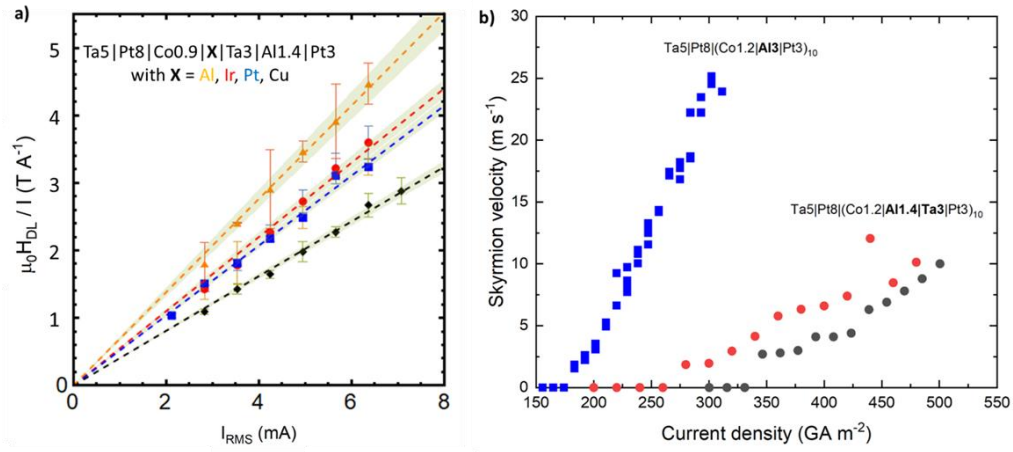

Figure 1: a) HDL measurement for Ta|Pt|Co|X|Ta|Al|Pt with (X=Al, Ir, Pt & Cu) b) Skyrmion velocity as a function of the current density for (Pt|Co|Al|Pt)10 and (Pt|Co|Al|Ta|Pt)10 (for two different track width).