Interfacial Anisotropy in Nonmagnetic-Material/Ferrimagnetic-Insulator Bilayers

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As magnetic film thickness approaches a few nm, interfacial magnetism and inversion symmetry breaking have given rise to intriguing phenomena such as perpendicular magnetic anisotropy and skyrmions stabilized by the interfacial Dzyaloshinskii-Moriya interaction. While interfacial magnetic anisotropy has been widely studied in metallic ferromagnets for decades, insulator-based systems have been largely unexplored. Meanwhile, interfacial magnetic anisotropy is a major manifestation of interfacial spin-orbit coupling (SOC) and a powerful tuning parameter that controls novel magnetic phases. Recently, magnetic-insulator based interfacial structures have generated significant interest because of the novel spin textures and spin transport phenomena discovered in these systems. Thus, understanding interfacial interactions in magnetic-insulator based systems will substantially impact various sub-fields of spintronics. In this talk, I will discuss our results on sizable interfacial magnetic anisotropy of $Tm_3Fe_5O_{12}$ (TmIG) epitaxial thin films capped with fifteen nonmagnetic materials (NM) including *d*-block transition metals and elements from the *p*-block of the periodical table [1]. The fifteen capping layers illuminate a strong correlation between interfacial magnetic anisotropy and the orbital characters of the NMs: the *d*-block overlayers induce large interfacial magnetic anisotropies while the *p*-block overlayers cause little change. Our results shed light on the effect of Rashba SOC on magnetic-insulator based systems, which have not been systemically studied before. Finally, I will contrast the interfacial magnetic anisotropy of the fifteen NMs on TmIG, which all induce in-plane interfacial anisotropy, with our recent results of $WTe_2/Y_3Fe_5O_{12}$ bilayers, which exhibits an out-of-plane interfacial magnetic anisotropy, due to the broken in-plane symmetry of WTe_2 overlayer [2]. This work offers a new path for controlling magnetic phases in magnetic insulators for low-loss spintronic applications.

References

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