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Temperature dependence of current induced effective spin-orbit torques in perpendicular magnetic anisotropy systems YONGXI OU, CHI-FENG PAI, GRAHAM ROWLANDS, JUNBO PARK, DANIEL RALPH, ROBERT BUHRMAN, Cornell Univ — We report measurements of the temperature dependence (T = 5-300 K) of current-induced spin-orbit torques for a variety of different heavy metal |ferromagnet |oxide (HM|FM|Oxide) multilayers with perpendicular magnetic anisotropy. Compared to the damping-like torque component, the field-like torque is much more sensitive to T, and generally, but not always, exhibits a quasi-linear variation with T. In some cases, this quasi-linear variation crosses zero, so that the field-like term reverses direction from being parallel to the Oersted field to being anti-parallel. Control experiments using a spacer material having a negligible spin Hall effect (SHE) show that both the field-like torque and the damping-like torque arise from the SHE in the HM layer. However, depending on the details of the FM-normal metal interfaces there is much greater variation in the strength and T behavior of the field-like torque, which points to a strong role for the interface in modifying the strength and direction of the field-like torque.

Yongxi Ou
Cornell Univ

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