Electrical Switching of Antiferromagnetic Spins in Pt/Fe_2O_3 Bilayers

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The ability to manipulate antiferromagnetic (AF) moments is a key requirement for the emerging field of antiferromagnetic spintronics. Electrical switching of bi-state AF moments has been demonstrated in metallic AFs, CuMnAs and Mn_2Au. Recently, current-induced switching of AF spins with saw-tooth shaped Hall resistance was reported in Pt/NiO bilayers. We report the demonstration of non-decaying, step-like electrical switching of tri-state Néel order in Pt/α-Fe_2O_3 bilayers. Our experimental data, together with Monte-Carlo simulations, reveal the clear mechanism of the switching behavior of α-Fe_2O_3 Néel order among three stable states. We also observe saw-tooth shaped Hall resistance, which is due to an artifact of Pt, while the signature of AF switching is step-like Hall signals. This demonstration of electrical control of magnetic moments in AF insulator films will expand the scope of AF spintronics by leveraging the large family of AF insulators.