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Single-shot antiferromagnetic switching in exchange biased IrMn/CoGd bilayer

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Ultrafast manipulation of magnetic order has challenged our understanding of the fundamental and dynamic properties of magnetic materials. Until now, single-shot magnetic switching has been limited to ferrimagnetic alloys, multilayers, and engineered ferromagnetic heterostructures [1-2]. In ferromagnetic (FM)/antiferromagnetic (AFM) bilayers, the exchange bias field (He) arises from interfacial exchange coupling and reflects the microscopic orientation of the antiferromagnet [3]. In our previous studies, we demonstrated single-shot switching of the antiferromagnet using a single femtosecond laser pulse in IrMn/CoGd bilayers (ref). We have shown that the exchange bias field can be manipulated across a wide range of laser fluences, layer thicknesses, and compositions [4]. We will show in the presentation that using element-specific circular dichroism X-ray resonant magnetic scattering (CD-XRMS), we can directly probe the depth and temperature dependence of uncompensated antiferromagnetic spins at the IrMn/CoGd interface. A time-resolved CD-XRMS experiment is scheduled at the FERMI free-electron laser facility to further investigate the ultrafast switching dynamics of Co and Mn in an element-selective manner. These dynamics are expected to reinforce our observation of ultrafast exchange bias switching. Our results present the fastest and most energy-efficient method for setting the exchange bias to date, opening new avenues for ultrafast spintronic device applications.

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