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Correlation between bulk magnetoelectricity and boundary magnetization in Cr_2O_3 JUNLEI WANG, CHRISTIAN BINEK, University of Nebraska-Lincoln — Boundary magnetization is a roughness insensitive net magnetization. It emerges at the surface or interface of a magnetoelectric antiferromagnet in a single-domain state and has been utilized in voltage controlled spintronic system for potential ultra-low power application based on exchange bias system with Cr_2O_3. Previous work has lacked to demonstrate the direct relation between the bulk spin structure and the boundary magnetization. In this work, we use magneto-optical Faraday effect to observe boundary magnetization and correlate it with the bulk magnetoelectric response of a Cr_2O_3 single crystal on an applied electric field, E. Our method discriminates the E- dependent bulk Faraday rotation, θ, from the stationary boundary magnetization. To this end we investigate θ vs. E in two distinct antiferromagnetic single-domain states which are prepared via magnetoelectric annealing. Temperature dependence of the boundary magnetization, $m_{BM} \propto \Theta(E = 0)$, as well as the corresponding bulk magnetoelectric susceptibility, $\alpha \propto \mathrm{d}\Theta/\mathrm{d}E$, is obtained from separate investigations of θ vs. $E$for the two single domain states. Our magneto-optical setup uses a near-infrared laser so that transmission loss is admissible for our sample of 500 μm thickness. We utilize lock-in and compensation techniques to maximize measurement precision and to enable absolute Faraday rotation measurement which is gauged with respect to magnetization.

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