Magnetic properties of aligned multiferroic Janus nanofiber agglomerates measured with the Scattered Magneto-Optical Kerr Effect

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1 Abstract

We report magnetic properties of electrospun multiferroic nanofibers assembled into linear agglomerates with an external magnetic field, and measured with the Magneto-Optical Kerr Effect (MOKE) in a non-specular or scattering geometry (ScMOKE). $CoFe_2O_4$-$BaTiO_2$ nanofiber aggregates are assembled prior to measurement by suspending and aligning the fibers in a transparent air-cured polyvinyl alcohol (PVA) solution. We detect the polarization change in light scattered from the fibers, collected at an off-specular angle in order to eliminate the large noise contribution caused by substrate reflections. Additional improvements in signal-to-noise are achieved by averaging many continuous field sweeps. Averaged hysteresis loops from different aggregates show a variety of unique structures. For our optical spot size of $\sim$15μm, multiple fibers are detected simultaneously, suggesting ScMOKE can distinguish local magnetization reversal fields that vary from fiber to fiber, as well as magnetic interactions between fibers. Compared with bulk

magnetometry, ScMOKE's sensitivity to subtle differences between aggregates offers a route to determine local multiferroic coupling in disordered nanomaterials[1], [2].

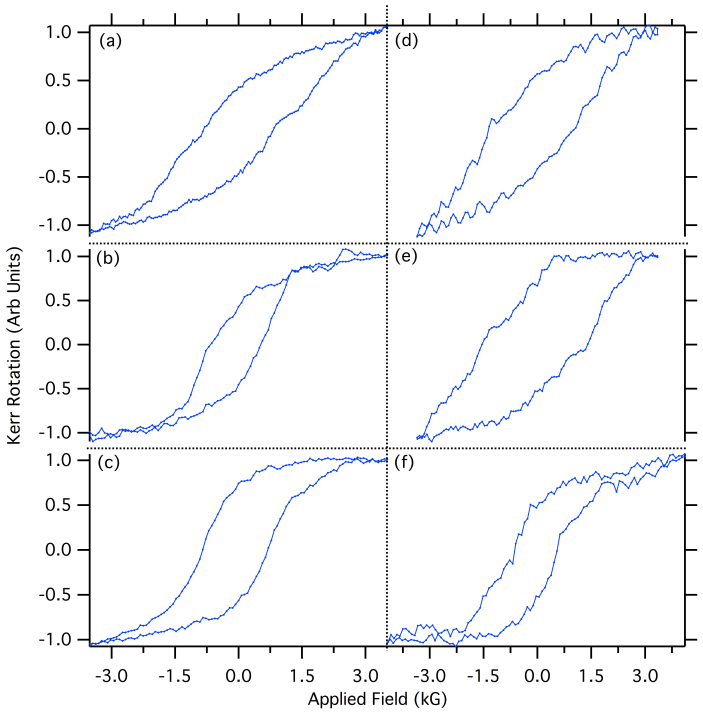

Figure 1: (a-f) Example ScMOKE hysteresis loops from multiple aligned fiber aggregates with diameters between 2-5 μm and lengths $\geq 40\mu$m, i.e. larger than the optical spot size. Note that both smooth and sharp curvature transitions occur, with minor-loop-style changes in magnetization at specific field values, especially in panels (a), (b), and (f). In fact, (f) has symmetric jumps suggesting a minor loop process, perhaps because of varying local fiber angle with respect to the applied magnetic field.

References

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