An XPEEM Study of Voltage-induced Magnetic Domain Separation in a LaSrMnO Thin Film

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$La_{0.7}Sr_{0.3}MnO$(LSMO) is a transition metal oxide that is a ferromagnetic metal at low temperatures and a paramagnetic insulator above its Curie temperature. It exhibits both resistive and magneticswitching properties[1,2]. Unlike most phase-change resistive switching materials that transition from aninsulator to a metal at elevated temperatures[3-6], LSMO transitions from a metal to an insulator as thetemperature increases. Applying a voltage bias above a critical value to a fabricated LSMO thin film device caninduce phase separation, forming a paramagnetic insulating barrier. In this study, we employed X-ray magneticcircular dichroism-photoemission electron microscopy (XMCD-PEEM) to observe magnetic domainconfigurations as a function of bias voltage. For voltages exceeding a certain threshold, magnetic domainssegregate into two distinct regions: one displaying clear white/black contrast, indicative of well-defined micron-scale magnetic domains, and the other showing intermediate gray contrast, characteristic of regions withreoriented magnetization. Significant changes in magnetic domain configurations were observed only in thegray areas. Furthermore, this voltage induced phase separation was found to depend on bias polarity, with thegray area expanding from the opposite sample edge when the applied voltage was reversed. These findingsdemonstrate the intricate voltage-induced domain dynamics in phase-change materials.

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