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Growth, microstructure and properties characterization of multiferroic heterostructures

Multiferroic heterostructures offer unique opportunities for room-temperature multifunctional devices by combining ferroelectric and magnetic films through interfaces. In this work, we investigated the growth and structural optimization of such heterostructures using pulsed laser deposition (PLD), focusing on the dependence between deposition conditions, crystallinity, and functional properties.

The study addresses three key elements: optimization of Pt bottom electrodes for stability and epitaxy, growth of barium hexaferrite (BaM) as the ferromagnetic component, and hexagonal ytterbium ferrite (h-$YbFeO_3$ /YbFO) as the multiferroic/ferroelectric layer. The role of the Pt electrode and the stacking sequence of BaM/YbFO were systematically examined to to investigate their impact on crystalline quality and functional properties. Pt electrodes significantly improved crystallinity and orientation, reduced mosaicity, and blocked the interdiffusion of subsequent oxide layers. In addition, the growth sequence of BaM and h-$YbFeO_3$ strongly influenced the magnetic and structural properties: BaM-first heterostructures showed enhanced magnetic anisotropy, sharper interfaces, and desired properties for heterostructure applications, whereas the reversed sequence led to higher defect densities and intermixed interface which were not desired.

These results highlight electrode growth, stacking order, and deposition parameters influence on the performance of oxide heterostructures, offering a pathway to tailor multiferroic thin films for next-generation magnetoelectric devices operating at room temperature.

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