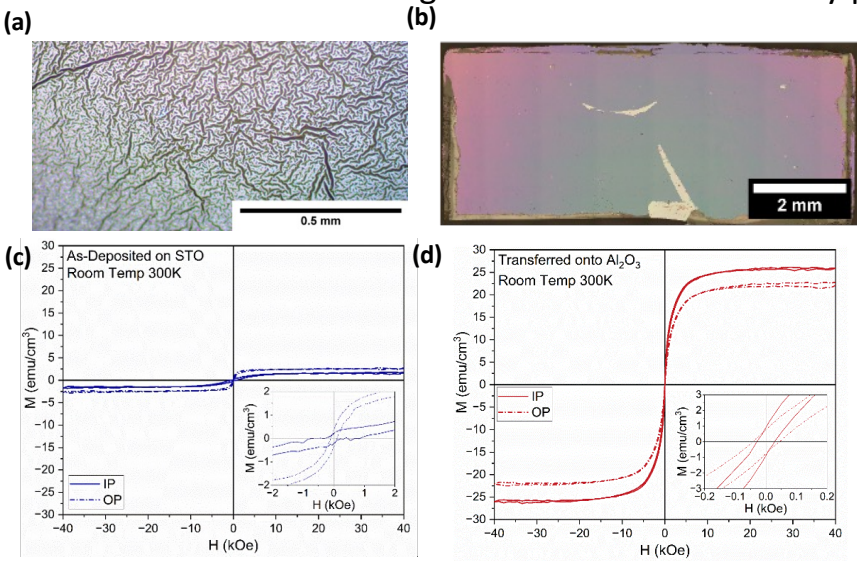
Transferring Millimeter-Scale Strained Multiferroic Epitaxial Thin Films

Scientific Achievement

We demonstrate a process using rigid substrate transfer to achieve the transfer of large, crack-free regions of $Bi_3Fe_2Mn_2O_x$ (BFMO) supercell films, which exhibit both ferromagnetism and ferroelectricity. This rigid substrate process enables the transfer of areas 10x larger than those achieved by previous methods.



(a) Optical image of traditional process for transferring $Bi_3Fe_2Mn_2O_x$ (BFMO) supercell films resulting in cracking and wrinkling. (b) Films transferred using rigid substrate process resulting in a 10x improvement in crack-free areas. Magnetic hysteresis curves for (c) as-deposited and (d) rigid transferred films with the magnetic saturation increasing from 2.5 emu/cm^3 to 26 emu/cm^3.

Significance and Impact

BFMO is a promising platform for memory devices, computing paradigms, acoustic sensors, and integrated photonics. The ability to transfer large areas of BFMO may lead to new surface acoustic wave devices, acoustically driven ferromagnetic resonance transducers, and four-state memory cells. This method is generalizable and can be used for transferring a variety of strained films.

Research Details

- Highly-strained layered supercells are epitaxially grown using pulsed layer deposition.
- The built-in strain is prevented from relaxing through epoxy bonding. Further strain control enables the clean removal of the epitaxial growth substrate.

Barnard, J. P.; Zhang, Y.; Quigley, L.; Shen, J.; Tsai, B. K.; Chhabra, M. R.; Noh, J.; Jung, H.; Mitrofanov, O.; Sarma, R.; Siddiqui, A.; Brener, I.; Doiron, C. F.; Wang, H. Transfer of Millimeter-scale Strained Multiferroic Epitaxial Thin Films on Rigid Substrates via an Epoxy Method Producing Magnetic Property Enhancement. *Advanced Electronic Materials* **2024**.

Work was performed, in part, at the Center for Integrated Nanotechnologies

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