Controlled Growth of Multiferroic Thin Films

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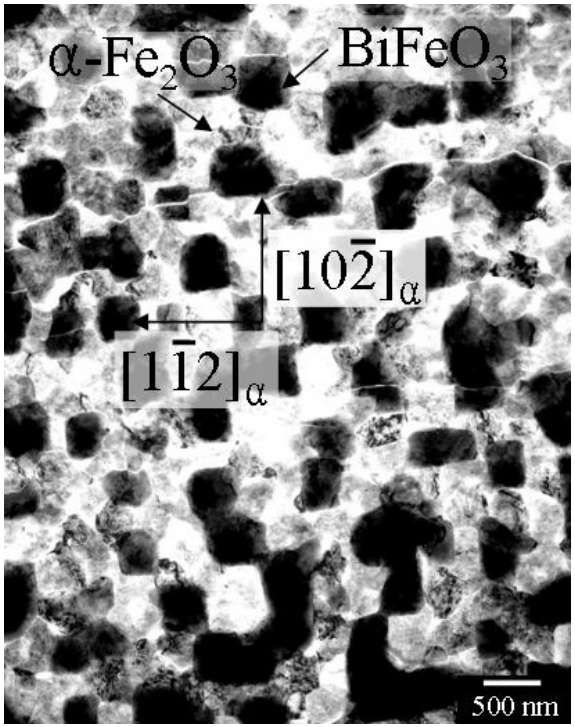
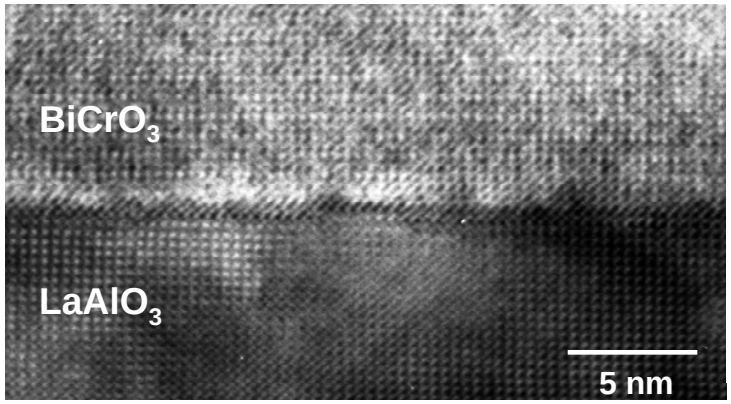
Ability to tailor physical properties is the key to applications of functional materials. In multiferroic oxides, magnetism and ferroelectricity coexist. Here we demonstrate that by fine-tuning the growth condition, Bi-Fe-O thin films can be grown as epitaxial nanocomposites consisting of ferroelectric $BiFeO_3$ and magnetic Fe_2O_3. By adjusting the oxygen pressure during the synthesis, the degree of mixture in the material can be continuously changed from pure $BiFeO_3$ to mostly Fe_2O_3 nanocomposite. Because γ-Fe_2O_3 has much higher magnetization compared to $BiFeO_3$, by tuning the deposition oxygen pressure, one can "dial-in" on the desired value of magnetization.



Microstructure of Multiferroic Thin Films

Top right: Planar transmission electron microscopy (TEM) image of epitaxial Bi-Fe-O nanocomposite showing separated grains of $BiFeO_3$and Fe_2O_3 .

Bottom right: In another experiment, new multiferroic $BiCrO_3$ was successfully stabilized as an epitaxial thin film using the laser molecular beam epitaxy technique. Multiferroic properties of $BiCrO_3$ were measured for the first time. The cross-sectional TEM image shows its atomically sharp interface with substrate.



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