Nanocomposites of multiferroic relaxor lead iron tantalate-lead iron tantalalum niobate

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Recently, there has been a lot of interest to understand the origin of ferroelectricity from the basic science point of view[1]. The recent discovery of byfunctional ferroic properties[2] in the common material platform had led to redefine the little known knowledge of the origin of spontaneous polarization in ferroelectric as well as ferroelectric-like relaxor materials. The evidence of the coupling between the ferroelectric–ferromagnetic properties has provided further motivation to gain the insight of the ferroelectric properties at the microscopic through magnetic measurements, and vise versa.

Magnetic heterostructures have been extensively studied which have revealed interesting behaviors useful for many technological applications as well as understanding the exchange interaction. The research in mutiferroic materials indicates that there could be a microscopic similarity in ferroelectricity and ferromagnetism. Therefore, it is expected to exhibit interesting ferroelectric properties in a system analogous to magnetic heterostructures.

We have successfully synthesized the composite structure of byfunctional relaxor material with a normal ferroelectric. The relaxor system that was chosen was lead iron niobate-lead iron tantalate solid solution, and the normal ferroelectric phase chosen was barium titanate. Composites both in one dimension as well as three dimensions were made, and the effect of the repeat distance as well as the relative sizes of the relaxor/normal ferroelectric elements was studied. The samples were grown by sol-gel and laser pulsed laser ablation on lattice-matched substrates in order to obtain the epitaxial thin film samples over a range of thickness determined by interface diffusion and stress relaxation. Three-dimensional composites were fabricated using a self-assembled porous structure as the host matrix and then filling it with the second phase. We have studied the coupling between two relaxor-like units through a normal ferroelectric layer. Several substrates were chosen to understand the influence of strain on this coupling across the interfaces, and also the overall properties. The properties were studied by the ferroelectric hysteresis and electrical impedance measurements at various temperatures. The phase transition behavior and relaxor properties of the system had also been verified by spectroscopic measurements.

References:

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