Universal behavior in structural and ferroelectric properties for RE-substituted BiFeO$_3$ thin films

By
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Host: Asst. Prof. Tom Wu

Abstract:
We have recently discovered substantial enhancement in dielectric/ferroelectric/piezoelectric properties at a rhombohedral to pseudo-orthorhombic structural boundary in (Bi,Sm)FeO$_3$.[1] In this talk, I would like to talk about systematic investigations on structural and ferroelectric properties of BiFeO$_3$ thin films doped with rare-earth (RE) elements of Sm, Gd and Dy in a combinatorial manner[2]. Thin film composition spreads of (Bi,RE)FeO$_3$ were fabricated by combinatorial pulsed laser deposition on SrTiO$_3$ (100) substrates with SrRuO$_3$ buffer layers. Scanning x-ray diffraction reveals that a rhombohedral to an orthorhombic structural transitions are universally observed for all RE elements studied here and that the structural properties can be described as a function of average ionic radius of A-site. This indicates that the primary cause of the transition is the chemical pressure effect due to the substitutions. We attribute the transition from a single ferroelectric hysteresis loop on the undoped BFO side to a double hysteresis loop on the orthorhombic side to an electric field induced structural transition at the boundary. In this presentation, we will also show from the orientation dependence of ferroelectric hysteresis loops that the polarization rotates from the [111] direction to the [001] direction with increasing dopant composition. This explains why we see the enhancement in piezoelectric coefficient along the [001] direction at the boundary [3].

This research was done in collaboration with V. Anbusathaiah, C. J. Cheng, V. Nagarajan and I. Takeuchi.

[3] D. Kan et al., to be published.

About the Speaker:
Education:
2001.3 Bachelor of Science Kyoto University (SV; Prof. Mitsuaki Nishijima)
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Employment Experience:
2006.4-2007.3 Researcher of Special Education and Research, Institute for Chemical Research (Shimakawa lab.), Kyoto University
2007.4-2009.3 JSPS Postdoctoral Fellow for Research Abroad (Prof. Ichiro Takeuchi, Univ. of Maryland)
2009.4-2010.3 Research Associate, University of Maryland
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