Microstructure Evolution in Solids with External Constraints and Defects

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A recent collaborative research with Professor Schlom at Penn State and other experimental groups lead to a discovery that a substrate constraint can be utilized to produce room-temperature ferroelectricity for a $SrTiO_3$ thin film which is otherwise nonferroelectric in a stress-free state. This discovery could lead to applications of $SrTiO_3$ thin films to microwave devices which require tunability of dielectric constant at microwave frequencies at *room-temperature*.

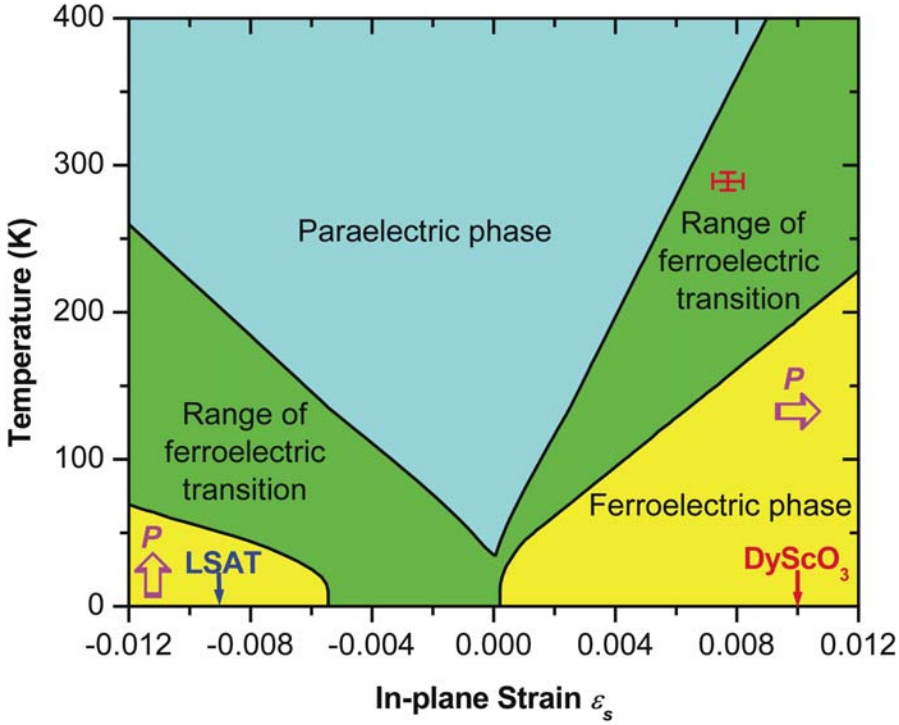

Fig. 1. Predicted shift in *Tc* of (100) $SrTiO_3$ with biaxial in-plane strain (ε_s), based on thermodynamic theory. The cross shows the observed *Tc* shift of a 500 Å thick $SrTiO_3$ film epitaxially grown on (110) DyScO3. (*Nature* **430**, 758 (2004)).

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Educational Impacts

- **One graduate student and one postdoctor are currently supported by the project. One graduate student who was partially supported by the project received his Ph.D. degree in 2004. One undergraduate student working on his B.S. thesis is the first-place winner in the speech context at the 2004 Annual meeting of the American Ceramic Society .**
- **The software developed in the project are being used in classroom demonstrations and hands-on experiences for two graduate courses and one undergraduate course.**

Fig. 2. the PI was a participant in the outreach activity at the University of Michigan—NASA's Summer High School Apprenticeship Research Program (SHARP) PLUS. He discuss the energetics of soap bubbles and allow students to explore these energetics with a hands-on activity in which the students make rafts of bubbles and watch what happens when the bubbles agglomerate.