THE MATERIALS SCIENCE AND ENGINEERING DEPARTMENT
FALL COLLOQUIUM SERIES PRESENTS:

Professor Darrell Schlom

Tisch University Professor in the Department of Materials Science

Cornell University

Stabilizing Improper Ferroelectricity in Thin Films Down to the Monolayer Limit

Scaling has long been the engine enabling economic and performance benefits for electronics. But how thin can a ferroelectric be scaled before it loses this functionality? This has been the subject of longstanding research and in the case of improper ferroelectrics, a major disagreement between theory and experiment. The prime issue in thin films of improper ferroelectrics has been that they clamp to substrates that lack a structural distortion; such clamping thwarts the needed structural distortion and thus ferroelectricity. In this talk I will describe the use of an insulating substrate covered by a conducting electrode and followed by a monolayer transition layer that are not improper ferroelectrics themselves, but that do possess a structural distortion akin to that of the improper ferroelectric deposited upon them by molecule-beam epitaxy. The result is ferroelectricity with an undiminished Curie temperature in a formula-unit-thick (0.5-unit-cell) improper ferroelectric hexagonal $LuFeO_3$ (h-$LuFeO_3$) film grown on a $SrCo_2Ru_4O_{11}$ bottom electrode with a carefully engineered monolayer transition layer. Our results demonstrate the absence of a critical thickness for improper ferroelectricity and provide a methodology for creating ultrathin improper ferroelectrics by stabilizing its primary order parameter.

Darrell Schlom is the Tisch University Professor in the Department of Materials Science and Engineering at Cornell University. He also holds an honorary affiliation as the first “Leibniz Chair” of the Leibniz-Institut für Kristallzüchtung (IKZ) in Berlin, Germany. After receiving a B.S. degree from Caltech and a Ph.D. from Stanford University, he was a post-doc at IBM’s research lab in Zurich, Switzerland. His research involves the heteroepitaxial growth and characterization of oxide thin films by reactive molecular-beam epitaxy (MBE), especially utilizing a “materialsby-design” approach to discover materials with properties superior to any known. His work has been recognized by the highest awards for materials discovery by five relevant societies: the MRS Medal from the *Materials Research Society*, the Frank Prize from the *International Organization for Crystal Growth*, the McGroddy Prize from the *American Physical Society*, the Thornton Memorial Award from the *American Vacuum Society*, and the John Bardeen Award from *The Minerals, Metals & Materials Society (TMS)*. He is a Fellow of the *American Physical Society*, the *Materials Research Society*, the *American Vacuum Society*, and is a member of the *National Academy of Engineering*.

Tuesday, October 15 • 4 pm CT • Tech L211

In person only; no Zoom

Questions? Contact allison.macknick@northwestern.edu