

Materials Science and Engineering

**2016 DORN MEMORIAL
LECTURE****Stephen J. Pennycook**

Professor

Department of Materials Science and Engineering
National University of Singapore**Tuesday, January 12, 2016****Tech L361, 4:00pm***Reception to follow**Cook Hall - Atrium, 5:15pm***“SCANNING TRANSMISSION ELECTRON
MICROSCOPY: TOWARDS ATOM-BY-ATOM IMAGING IN
THREE DIMENSIONS”**

In Feynman's famous 1959 lecture “There's Plenty of Room at the Bottom,” he challenged us to improve the electron microscope 100 times, so we could “just look at the thing.” With the spectacular advances in aberration correction of the last decade, we have improved image resolution to well below 1 Å and gained a new level of sensitivity to structure, bonding, elemental valence and even spin state. We are able to image atomic diffusion within a solid, identify active sites in a catalyst and explain the unexpected ferromagnetism in ultrathin, insulating LaCoO_{3-x} (LCO) films. We can understand the surprising impact of interface termination on ferroelectricity in BiFeO_3 (BFO) films grown on $\text{La}_{0.5}\text{Sr}_{0.5}\text{MnO}_{3-x}$ (LSMO), and how grain boundaries in CdTe solar cells improve cell efficiency. We can watch the dynamics of nanoclusters and nanowires. But today's microscope is only 20 times better than in Feynman's time. If we were to achieve another factor of two in lateral resolution we would achieve a depth resolution at the atomic level, opening the door to microscopic studies of whole new classes of materials by optical sectioning [1-3]. Finally we may be able to see the atomic structure of glasses, nanophase materials and those so-called “random” grain boundaries.

Biography: Stephen J. Pennycook is a Professor in the Materials Science and Engineering Dept., National University of Singapore, an Adjunct Professor in the University of Tennessee and Adjoint Professor in Vanderbilt University, USA. Previously, he was Corporate Fellow in the Materials Science and Technology Division of Oak Ridge National Laboratory and leader of the Scanning Transmission Electron Microscopy Group. He completed his PhD in physics at the Cavendish Laboratory, University of Cambridge in 1978. Pennycook is a Fellow of the American Physical Society, the American Association for the Advancement of Science, the Microscopy Society of America, the Institute of Physics and the Materials Research Society. He has received the Microbeam Analysis Society Heinrich Award, the Materials Research Society Medal, the Institute of Physics Thomas J. Young Medal and Award and the Materials Research Society Innovation in Characterization Award. He has 38 books and book chapters, over 400 publications in refereed journals and has given over 200 invited presentations on the development and application of atomic resolution Z-contrast microscopy and electron energy loss spectroscopy. His latest book is “Scanning Transmission Electron Microscopy.”