

**MI 3: Plenary Talk Pennycook (PV II)**

Chair: Hartmut S. Leipner

Time: Monday 14:00–14:45

Location: H1

**Plenary Talk**

MI 3.1 Mon 14:00 H1

**Exploring the Functionality of Advanced Materials through Scanning Transmission Electron Microscopy** — ●STEPHEN PENNYCOOK — Oak Ridge National Laboratory, Oak Ridge, TN, USA

The scanning transmission electron microscope can today form probes of sub-Ångstrom dimensions with sufficient current for electron energy loss spectroscopy. Not only can single atoms be imaged and identified, but their electronic structure, optical properties and even their dynamics can be studied.

In monolayer materials such as BN and graphene, stable point defect complexes consisting of substitutional Si and N atoms lead to localized surface plasmon resonances at the sub-nanometer scale. Core loss spec-

troscopy is able to identify the nature of their bonding, distinguishing sp<sup>3</sup> from sp<sup>2</sup>d configurations, confirmed by density functional theory. The STEM probe can also be used to gently excite the dynamics of small clusters. A Si<sub>6</sub> magic cluster embedded in a small hole in monolayer graphene explores a number of metastable configurations.

In complex oxide materials the ability to measure transition metal valence, to track oxygen vacancy ordering and to measure atomic positions to picometer levels has produced new insights into their functionality. Examples will be presented from multiferroics, cobaltites and ionic conductors. Future directions to directly map functionality at the nanoscale will be discussed.

Research supported by the U.S. Department of Energy, Basic Energy Sciences, Materials Sciences and Engineering Division.