Physics Colloquium

University of Missouri-Kansas City
Department of Physics

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University of Illinois at Urbana-Champaign

Scanning Electron Microscopy and Transmission Electron Microscopy in Materials Research

Electron microscopy is an extension of optical microscopy. It offers much higher lateral resolution (due to the shorter wave length of high-energy charged particles) and higher depth of focus. The Scanning Electron Microscope (SEM) is the most widely-used type of electron microscope that images the sample surface-close layers by scanning it with a beam of electrons in a raster scan pattern. The electrons interact with the atoms that make up the sample producing signals that contain information about the sample's surface topography, composition and other properties. Analytical modes of operation include X-ray Energy Dispersive Spectroscopy (X-EDS), Wavelength Dispersive X-ray Spectroscopy (WDS), Electron Backscatter Diffraction (EBSD), Electron Beam Induced Current (EBIC), Cathodoluminescence (CL) and other. Transmission Electron Microscopy (TEM) is a technique where a near-parallel beam of electrons is transmitted through an ultra thin specimen, interacting with the specimen as it passes through it. An image is formed from the electrons transmitted through the specimen, magnified and focused by an objective lens and appears on an imaging screen. Scanning Transmission Electron Microscopy (STEM) offers unique and easily interpretable contrast (mostly in HAADF mode) and enables analytical operation (mostly through X-EDS and Electron Energy Loss Spectroscopy, EELS). SEM and STEM offer both spectro-microscopic (e.g. Energy-Filtered TEM) and micro-spectroscopic modes of operation. Measurements of texture and mosaicity are available by acquisition of electron diffractograms in the TEM or of EBSD patterns in the SEM.

The focus of the presentation is on the description of the techniques' details, capabilities and advantages. It will be illustrated by examples from the "nano-world".

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Coffee at 3:10, Colloquium at 3:30 in Room 310