MAR05-2004-005074

Abstract for an Invited Paper
for the MAR05 Meeting of
the American Physical Society

Synchrotron X-Ray and Magnetic Susceptibility Probes in Diamond-Anvil Cell

HO-KWANG MAO, Carnegie Institution of Washington

Multiple x-ray and allied techniques have been developed and integrated at synchrotron facilities focusing on a unified scientific goal – exploring the rich behavior of materials under extreme pressures and temperatures. A plethora of synchrotron x-ray inelastic spectroscopic techniques has been introduced and applied, many of them for the first time, for high-pressure (HP) applications. These include *HP x-ray emission spectroscope* which analyzes energies of the x-ray fluorescent photons with sub-eV energy resolution of the emission spectral lineshape to provide valuable information on the filled electronic states of the HP samples, *HP x-ray inelastic near-edge spectroscopy* which opens a wide new field of HP chemical bonding studies of the light elements, *HP electronic inelastic x-ray scattering spectroscopy* which provides unlimited access to high energy electronic phenomena, including electronic band structure, Fermi surface, excitons, plasmons, and their dispersions at HP, *HP resonant inelastic x-ray scattering spectroscopy* which probes shallow core excitations and multiplet structures for highly correlated electronic systems as well as spin-resolved electronic structures for magnetic samples, and *HP nuclear resonant x-ray spectroscopy* which reveals phonon densities of state and time-resolved Mössbauer information. These new tools integrated with the existing magnetic susceptibility and electrical conductivity probes are unleashing the full power of high pressure in numerous scientific disciplines. Fundamental understanding in electronic structure, from simple electron gas to strongly-correlated systems, will be manifested through tuning of the pressure variable. New rules of crystal structure and superconductivity, for example, will be established across the Periodic Table in each pressure regime.