Abstract for an Invited Paper
for the MAR09 Meeting of
The American Physical Society

Mbar Chemistry: Novel States of Matter in Extreme Conditions

CHOONG-SHIK YOO, Department of Chemistry and Institute for Shock Physics, Washington State University, Pullman, Washington 99164-2816 USA

Compression energy at 100 GPa often exceed several eV/atom, rivaling the energy of strong chemical bonds. Therefore, the application of such a high pressure significantly alters the chemical, electronic/optical, thermomechanical properties of solids and, in turn, provides a way to test condensed matter theory and to exploit novel materials with advanced properties. Furthermore, reeent advances in diamond-anvil cell high-pressure technologies coupled with advanced third-generation synchrotron x-ray offer unprecedented opportunities to discover exotic states of matter at high pressure-temperature conditions of the Earth and planetary interiors. In this paper, I will discuss several recent results of high-pressure chemistries that occur in simple low Z molecular solids to novel novel nonmolecular extended solids. Broadly speaking, these molecular-to-nonmolecular transitions occur as a result of the pressure-induced electron delocalization arising from a rapid increase in electron kinetic energy at high density. Yet, the details are substantially more complicated because of the phase metastability, large lattice strain, and governing kinetics. As a result, there are many outstanding questions regarding the exact nature of chemical bonding, phase stability, and transition mechanisms. Also, presented are several future directions of high pressure materials research in an complementary phase and time scales of dynamic and static high pressures.