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Percy Bridgman Award Talk - Stressed solids probed by diffraction and spectroscopy

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Since the pioneering experimental studies of Percy W. Bridgman, an enormous progress in high pressure research has resulted in tremendous gains of knowledge about materials behavior over a wide range of pressures. Today's experimental studies of solids take advantage of numerous developments in pressure-cell techniques and advances in analytical methods that utilize synchrotron x-ray radiation (diffraction as well as inelastic scattering), lowtemperature optical spectroscopies, and synchrotron infrared spectroscopy. The subjects of interest range from fundamental questions about phase stability, crystal structure formation, and the nature of interatomic bonding to illuminating the interplay between subtle changes in atomic arrangements, electron delocalization, magnetism, and superconductivity. In this presentation I intend to brie y highlight (i) selected contributions of diamond-cell-based research to understanding electrons, phonons, and other quasiparticles in 'conventional' semiconductors and (ii) the more recent surprises in the
eld of phase stability of non-transition metals. The main focus will be on structural and electronic properties of transition metal compounds located near the insulator-metal borderline. There, the orbital physics of perovskite-related titanites and vanadates (pressure-induced rearrangement of t2g states and related insulator to metal transitions) has attracted attention. Pressurizing multiferroic spinels leads to structural diversity and oxidation state changes when entering into a metallic regime. And by revisiting one of the cuprate superconductors it reveals polymorphism which may call for a reinterpretation of the Tc maximum induced by pressure. These examples from experiment indicate where the advanced models of correlated electron systems are expected follow up on the considerable success of theoretical physics in accounting for or predicting pressure effects in solids. Abstract AIRAPT