New High Pressure and High Temperature Brillouin Spectroscopy Capabilities at LANL

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Abstract

Several techniques for the determination of material elastic properties exist, including differential thermal analysis, ultrasonic interferometry, and impulse stimulated scattering. However, few are as well suited as Brillouin spectroscopy for *in situ* high pressure and high temperature determination of the elastic properties of liquids and glasses. Brillouin spectroscopy is particularly well suited for the study of both refractory materials as well as less stable molecular crystals due to its small, ~30 micron diameter, sample size requirements and its non-destructive nature. Motivated by interest in studying both silicates and molecular crystals under compression, a Brillouin spectroscopy system with externally-heated diamond anvil cell and separate cryogenic-80^{o}C temperature control capabilities has been developed at Los Alamos National Laboratory. Results from two primary studies will be presented to highlight the range of new capabilities.

We are investigating the elastic properties of various majorite-garnet compositions including hydrous compositions under P-T conditions up to 26 GPa and 1000^{o}C, representative of the mantle transition zone. The dependence of elastic moduli on majoritic component and hydration will be used to evaluate mineralogical models of the mantle as constrained by seismic velocities.

Hexamethylenetetramine (HMT) is a globular, cage like, organic molecule, which crystalizes into a cubic structure. A precursor to the secondary explosive RDX, used to make solid fuel tablets, and used as a hardening component in synthetic resins, HMT is a common and important molecular material. Here we determine the temperature dependence of HMT elasticity for comparison with calculated elastic properties.