High Pressure Brillouin Scattering Study of Lubricants

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High pressure Brillouin scattering measurements were performed for synthetic lubricating oil using a diamond anvil cell as a high pressure sample cell. A sample lubricant used is Di(2-ethylhexyl) sebacate which is one of the common transmitting fluids used in pressure balances and used as a base oil in several lubricants. Pressure dependences of sound velocities and refractive indices at room temperature at pressures up to 5 GPa were obtained from Brillouin frequency shifts measured in 90° scattering geometry. The refractive index was obtained from the ratio of the Brillouin frequency assigned 90° scattering geometry to the shift frequency assigned 180° back scattering. The optical system for Brillouin spectroscopy was set up using six-pass (3 x 2) Sandercock type tandem Fabry-Perot interferometer . The etalon spacings (2, 4, 8 mm) were chosen in order to clarify the 90° and 180° Brillouin spectra at high pressure. The Ruby fluorescence spectrometer for pressure measurements in the diamond anvil cell was set up using imaging monochrometer and diode array detector. The pressure dependence of the density was obtained through the thermodynamic relation using the obtained pressure dependence of the sound velocities and the ratio of the specific heat at constant pressure to constant volume. The density data were also derived from the Lorentz-Lorenz formula using the obtained refractive indices.