Japan Geoscience Union Meeting 2010
(May 23-28 2010 at Makuhari, Chiba, Japan)

SCG004-11 Room: 302 Time: May 25 11:45-12:00

Development of Angle-dispersive Brillouin scattering measurement for geofluids

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We are currently studying local structures of fluids, melts, and supercritical fluids in Bassett-type hydrothermal diamond anvil cell (HDAC) using micro-Raman and FT-IR spectroscopy. In order to fully understand behaviors of such geofluids, we also need to measure physical properties of geofluids. In this paper, we discuss construction of angle-dispersive type Brillouin scattering spectrometer to measure velocity of fluids in HDAC.
Angle-dispersive type Brillouin measurement has been used in past, but is now replaced with Sandercock-type multi-pass and wave-length scan method. However, angle-dispersive method has several advantages over Sandercock-type, such as simple optics, high stability, and short measurement time as dispersed spectrum can be taken by CCD detector at once.
Single longitudinal mode 532nm laser with 100 mW output is used as a light source, and focused on sample by an objective lens, and scattering from the sample is corrected with same lens. Stray light, fluorescence and Raman scattering are removed by a space filter and a 532 nm laser line filter. In front of solid etalon, a rod lens is placed to disperse incoming ray into the etalon. Resultant interference image is focused to CCD detector by another lens. We are currently testing and modifying the optical system for best performance.
We are planning the measurement in backscattering geometry. However, for this geometry obtained Brillouin shift is a function of refractive index of sample. Therefore, the refractive index should be measured independently. For this purpose, we employ a technique developed in medical science (Fukano and Yamaguchi, Optics Letters, 21, 1942, 1996), which use Michelson interferometer with low coherence light source. This interferometer can be applied to the fluids in HDAC, and can obtain refractive index and also thickness. This interferometer is under construction.
Final goal of this study is to obtain local structural information of the sample in HDAC by Raman and IR, and get velocity data using Brillouin scattering, and establish structural vs velocity relationship of the geofluids.

Keywords: fluid, elastic wave velocity, Brillouin scattering, Fabry-Perot interferometer, etalon, angle-dispersive