Thermal Diffusivity Measurement for Earth's Interior Materials under High Pressure using Pulsed Light Heating Thermoreflectance

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The thermal transport properties in the Earth's interior determines the magnitude of heat flux from the core to mantle, and is intimately related to the formation of mantle plumes, the long-term thermal evolution of both mantle and core, and the driving force for generation of the geomagnetic field. The pressure of the Earth's interior drastically increases as the depth from the surface of the Earth becomes deeper; several hundred MPa at the region of the crust, ~20 GPa at the upper mantle and ~130 GPa at the lower mantle. We have adapted a pulsed light heating thermoreflectance technique to a diamond anvil cell in order to obtain thermal diffusivity under high pressures. A planar sample coated with Pt layers on both sides was loaded into a hole drilled in a rhenium foil gasket together with insulation layers of NaCl as a pressure medium. Subsequently, the sample was compressed with diamond anvils. Then, a front face of the sample was heated by laser pulses with duration of 2 ns and a wavelength of 1064 nm. To probe temperature change at a back face of the sample, a continuous wave laser beam with a wavelength of 782 nm was incident on the back face of the sample. Using a reflected intensity of the continuous wave laser beam, a transient temperature curve was measured when the heat transferred across Pt/sample/Pt layers. In this paper, we also demonstrate analysis method on a transient temperature curve and measurement results on deep mantle materials at the pressure over 100 GPa.