Thermoelastic properties of liquid metals measured by picosecond acoustics

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Picosecond acoustics (PA) is a time-resolved optical pump-probe technique based on reflectivity measurements used to study the propagation of acoustic waves in a large variety of samples at different pressure and temperature conditions [1, 2]. When associated with a resistively heated diamond anvil cell (RHDAC), it allows the precise determination of structural, thermoelastic and thermodynamic properties of materials through sound velocity measurements including equation of state [3], melting curves [5, 8], phase diagrams, or quantum effects [4, 6, 7].

In such experiments, it is possible to simultaneously measure the external conditions – of pressure and temperature – by recording transit time or surface phonon imaging consequently deducing the physical state and properties of the sample (liquid or solid) with a great accuracy.

The versatility and capabilities of PA combined with RHDAC will be illustrated with some results obtained in various liquid metals : the melting line of Indium [8], the complex variations in sound velocity of liquid alkali (Rubidium [7] and Cesium [6]) related to their "electride" state, or the opportunity for detecting liquid-liquid phase transitions in the stable or metastable liquid state of Gallium [5] and Bismuth [9].

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