Time differentiated nuclear resonance spectroscopy with pulsed laser heating in diamond anvil cells

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Continuous laser heating in diamond anvil cells is a widely used method to generate extreme temperature at static high pressure conditions in order to study structure and properties of matter at the conditions relevant to deep planet' interiors [1]. Pulsed laser heating offers many advantages over continuous heating for techniques with long data acquisition time: it preserves the integrity of the sample preventing spreading of the heated material and/or of the pressure medium and minimizes any undesirable chemical reaction.

Here we report on the first combination of time differentiated Nuclear Forward Scattering (NFS), Nuclear Inelastic Scattering (NIS), and Synchrotron Mössbauer Source (SMS) spectroscopy with pulsed laser heating in diamond anvil cells, successfully tested at the Nuclear Resonance beamline (ID18) of the European Synchrotron Radiation Facility (ESRF).

The time dependence of the laser pulse was used to define the delays and widths of the acquisition gates, for separate acquisition of the data from hot and cold sample (Fig. 1). We will present the details of the detection schemes and application of the approach to studies of geophysically relevant materials.

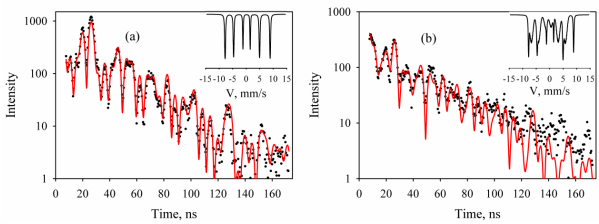

Figure. 1. Time spectra of nuclear forward scattering for Fe_2O_3 at 23(3) GPa at T=300 K (a) and at T=1400 (70) K (b).

[1] Kupenko et al. (2012) *Rev. Sci. Instrum.*, **83** , 124501.