Melt detection of candidate core materials at high pressures using atomic dynamics measurements and a fast temperature readout system

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We have developed a new *in situ* metric for detecting the solid-liquid phase boundary of Fe-bearing materials at high-pressures using synchrotron Mössbauer spectroscopy (SMS). The signal is characterized by the Lamb-Mössbauer factor, a quantity that is directly related to the mean-square displacement of the Fe atoms. The SMS technique provides a new and independent means of melting point determination, as well as access to vibrational properties of the solid near its melting point [1]. Accurate melting temperature of the sample is also a necessary factor in constructing reliable melting curves. To accurately capture the sample's transient temperature fluctuations and reduce uncertainties in melting temperatures, we have developed a Fast Temperature Readout (FasTeR) system in-line with SMS measurements under extreme conditions at Sector 3-ID-B of the Advanced Photon Source. Dedicated to determining the sample's temperature near its melting point, FasTeR features a fast readout rate (~100 Hz), high sensitivity, large dynamic range and well-constrained focus. The SIMX module, within the software package MINUTI [2], has been developed to determine the melting point from SMS data using physically based modeling. By combining SMS, FasTeR and SIMX, we have successfully carried out measurements on candidate core materials to determine the melting points by monitoring the atomic dynamics.

[1] Jackson et al (2013) *EPSL* **362,** 143-150 [2] Sturhahn, W.S. (2013) http://www.nrixs.com