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Temperature Measurements of Shocked Crystals by Use of Nanosecond X-ray Diffraction WILLIAM MURPHY, ANDREW HIGGINBOTHAM, JUSTIN WARK, University of Oxford, UK, NIGEL PARK, AWE, Aldermaston, UK — Over the past few years we have been pioneering the use of sub-nanosecond X-ray diffraction to determine the phase and compression of shocked crystals. It is well known that the deviation of atoms from their ideal lattice sites due to thermal motion reduces the integrated intensity within diffraction peaks - the so-called Debye-Waller effect, and thus it is pertinent to investigate whether line ratios might be sufficiently sensitive to be used as a viable temperature diagnostic. Clearly the matter is not completely straight-forward, as the Debye frequency of a solid also varies under compression. In our initial investigations we have calculated the ratios of intensities of high-order reflections assuming various forms of the Gruneisen parameter, and have also compared these results with those obtained from Molecular Dynamics simulations. We also note that under isentropic compression high order reflections monotonically increase in intensity. Given the photon energies of nanosecond X-ray pulses that can currently be produced, we comment on the experimental feasibility of the technique.

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