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The behavior of single-crystal silicon to dynamic loading using in-situ X-ray diffraction and phase contrast imaging[1] HAE JA LEE, ZHOU XING, ERIC GALTIER, BRICE ARNOLD, EDUARDO GRANADOS, SHAUGHNESSY B. BROWN, FRANZ TAVELLA, EMMA MCBRIDE, ALAN FRY, BOB NAGLER, SLAC National Accelerator Laboratory, ANDREAS SCHROPP, FRANK SEIBOTH, DIRK SAMBERG, CHRISTIAN SCHROER, DESY, ARIANNA E. GLEASON, Los Alamos National Laboratory, ANDREW HIGGINBOTHAM, University of York — Hydrostatic and uniaxial compression studies have revealed that crystalline silicon undergoes phase transitions from a cubic diamond structure to a variety of phases including orthorhombic Imma phase, body-centered tetragonal phase, and a hexagonal primitive phase [1, 2]. The dynamic response of silicon at high pressure, however, is not well understood. Phase contrast imaging has proven to be a powerful tool for probing density changes caused by the shock propagation into a material [3]. In order to characterize the elastic and phase transitions, we image shock waves in Si with high spatial resolution using the LCLS X-ray free electron laser and Matter in Extreme Conditions instrument. In this study, the long pulse optical laser with pseudo-flat top shape creates high pressures up to 60 GPa. We measure the crystal structure by observing X-ray diffraction orthogonal to the shock propagation direction over a range of pressures. We describe the capability of simultaneously performing phase contrast imaging and in situ X-ray diffraction during shock loading and discuss the dynamic response of Si in high-pressure phases. [1] Jamieson, Science, 139, 762 (1963); Hu et al. Phys. Rev.B 34, 4679 (1986) [2] McMahon and Nelmes, Phys. Rev. B 47, 8337 (1993); Mogni et al. Phys. Rev. B 89, 064104 (2014) [3] Nagler et al. J. Synchrotron Rad. 22 (2015); Schropp et al. Scientific Reports 5, 11089 (2015)

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