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In situ observation of high-pressure phase transition in silicon carbide under shock loading using ultrafast x-ray diffraction

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SiC is an important high-strength ceramic material used for a range of technological applications, including lightweight impact shielding and abrasives. SiC is also relevant to geology and planetary science. It may be a host of reduced carbon in the Earth's interior and also occurs in meteorites and impact sites. SiC has also been put forward as a possible major constituent in the proposed class of extra-solar planets known as carbon planets. Previous studies have used wave profile measurements to identify a phase transition under shock loading near 1 Mbar, but lattice-level structural information was not obtained. Here we present the behavior of silicon carbide under shock loading as investigated through a series of time-resolved pump-probe x-ray diffraction measurements up to 200 GPa. Our experiments were conducted at the Materials in Extreme Conditions beamline of the Linac Coherent Light Source. *In situ* x-ray diffraction data on shock-compressed SiC was collected using a free electron laser source combined with a pulsed high-energy laser. These measurements allow for the determination of time-dependent atomic arrangements, demonstrating that the wurtzite phase of SiC transforms directly to the B1 structure. Our measurements also reveal details of the material texture evolution under shock loading and release.