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X-ray diffraction of solid tin to 1.2 TPa[1] AMY LAZICKI, RYAN RYGG, FEDERICA COPPARI, RAY SMITH, DAYNE FRATANDUONO, DAVE BRAUN, RICHARD KRAUS, DAMIAN SWIFT, GILBERT COLLINS, JON EGGERT, Lawrence Livermore National Laboratory — We present x-ray diffraction studies of solid crystal structure at the highest stress state where such measurements have ever been performed. Using laser-driven ramp compression methods coupled with angle-resolved powder x-ray diffraction at the Omega laser facility, we explore the phase diagram of tin below the melting curve between 0.1 and 1.2 terapascals (TPa). We demonstrate that, at dynamic-compression rates on the order of 10^7 s^{-1}, tin transforms from the ambient tetragonal beta-Sn phase to the stable high pressure body-centered cubic (bcc) phase with densities consistent with static-compression measurements. Above 0.16 TPa our experiments identify a new feature in the phase diagram: a crystal structure clearly inconsistent with the hexagonal-close-packed (hcp) phase identified at these conditions by ambient-temperature static-compression measurements and by zero-kelvin density functional theory structure predictions. Our results suggest that the bcc phase is stabilized relative to hcp at high temperature, analogous to the heavier group IV metal Pb and numerous other elemental metals, and retains this phase during ramp compression to 1.2 TPa.

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