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Solid-solid, melting, and solidification phase transitions in shock-compressed silicon[1] STEFAN TURNEAURE, SURINDER SHARMA, YOGENDRA GUPTA, Washington State University — Solid-solid structural changes, melting, and recrystallization were examined in shock-compressed silicon using in situ synchrotron x-ray diffraction (XRD) measurements at the Dynamic Compression Sector. Flat-faced LiF(100) crystals impacted Si(100) samples resulting in impact stresses up to 52 GPa. Four x-ray diffraction measurements (100 ps duration; 153.4 ns between measurements) were recorded during the impact event providing time evolution of the structural changes at different stresses. For shock stresses less than ∼30 GPa, shock-compressed Si transformed to a highly textured simple hexagonal structure. Shock-melting, along the Hugoniot, was unambiguously established above ∼31-33 GPa by the disappearance of all crystalline diffraction peaks. Reshock from the melt boundary resulted in rapid (nanosecond) crystallization to the hexagonal-close-packed structure. These are the first direct in situ measurements showing recrystallization from the shock melted state.

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