Phase Transition Kinetics in Extreme States of Matter: A Novel Setup for in situ Diffraction at X-ray FELs

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Understanding the structure and behaviour of matter at extreme pressures and temperatures is of critical importance for many fundamental physics applications. This includes geophysics, planetary science and astrophysics, as well as shock and plasma physics. At LCLS in Stanford high-quality diffraction patterns of shock-compressed matter can be collected in a single pulse, making it ideal for time-resolved structural studies. This project concerns the development of a novel setup for in situ X-ray diffraction of shock-compressed matter at free-electron lasers allowing the investigation of phase transition kinetics. The key difference from the standard setup is that this innovative configuration measures diffraction patterns perpendicular to the shock propagation direction, taking snapshots along the shock wave. Given the operating energy of LCLS, the focus is on low-Z elements and compounds. With the advent of the European XFEL this technique can be extended to higher-Z elements revolutionizing our understanding of phase diagrams for matter under extreme conditions.

Projektbeteiligte

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Phase transition lowering in dynamically compressed silicon