Diamond anvil cell research at the High Energy Density instrument of European XFEL

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European XFEL delivers bursts of intense, coherent, fs- hard x-ray pulses to the HED instrument [1], providing new opportunities for diamond anvil cell research: The hard x-rays penetrate the complex sample environment and provide good coverage in the limited geometric aperture for diffraction experiments. The coherence is key for ultimate focusing and x-ray imaging techniques. The peak intensity enables direct and indirect x-ray heating of the samples, to induce phase transitions, and to iniate chemical reactions. The unique time structure in combination with fast detectors allows one to probe the temporal evolution of these processes with MHz time-resolution. In order to fully exploit this potential, a dedicated platform for diamond anvil cell research [2] integrating a pulsed infrared laser heating system [3] and streaked optical pyrometry [4] was installed at the HED instrument. We show groundbreaking experiments to explore the location of phase transitions including melting lines [5], to investigate the material response at different strain rates [6], to initiate and probe chemical reactions [7,8], and to study material properties at extreme temperatures and pressures [9].

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