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Laser-melting Bismuth - A case study for X-ray imaging at high pressure and temperature

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Our understanding on how opaque materials respond to extreme compression and high temperatures heavily relies on x-ray techniques. While X-ray diffraction is a powerful approach, some properties such as viscosity are experimentally not accessible with such approaches. Application of x-ray imaging has been widely applied in extreme pressure and temperature conditions using multi-anvil presses, but obtaining sufficient space and time resolution for similar experiments using diamond anvil cells, at commensurately higher pressure and temperature conditions, have been challenging. We present recent developments in synchrotron X-ray imaging at the ECB beamline at PETRA III, DESY used in combination with laser heated DAC. Simultaneous X-ray imaging and diffraction allows for deeper insight in properties of materials under high pressure as well as the direct correspondence of phase transition diagnostics. We present a case study of bismuth in the laser-heated diamond anvil cell showing detection of solid-solid and solid-liquid transitions and explore how X-ray imaging can be used to determine viscosity of molten bismuth under pressure.