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Ultrafast, high resolution, phase contrast imaging of shock response with synchrotron radiation: opportunities and challenges

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Designing materials that function at dynamic extremes and predicting dynamic materials response require experimental investigations of their time, rate and microstructure dependences. Key to such experiments are *in situ*, in-volume, temporally and spatially resolved measurements (e.g., x-ray imaging and diffraction). Here we report ultrafast (<100 ps), high resolution (~3 μm), dynamic phase contrast imaging (PCI) measurements during high rate loading (100 ns scale). A gas gun was installed at the Advanced Photon Source for dynamic loading, and dynamic PCI measurements were performed with a single x-ray pulse on representative materials/processes, including cylinder impact and penetration, large-cell foam compaction, cerium jet formation and granular material compression. We present overall experimental scheme and opportunities for dynamic materials research as seen from the preliminary results, as well as challenges both for photon sources and detectors.