Dynamic X-ray imaging of transient physical processes during impact loading

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Shock loading may produce a number of unique transformations in materials, both physical and chemical, which influence behaviour and ultimately define performance in engineering applications. Often their origins are linked to subsurface processes which are challenging to diagnose using conventional high-speed diagnostics. In this talk, we describe our efforts to develop a dynamic X-ray imaging capability at the Diamond Light Source for study of transient physical processes in cm-scale, high-Z materials. Using a portable purpose-built small-bore launcher, dynamic loading experiments were performed on the I12 high-energy beamline, synchronised to a custom hybrid bunch mode. A combination of pre-shot tomography and simultaneous line VISAR, HetV and dynamic X-ray imaging was used to study a range of dynamic damage phenomena. Preliminary results on the compression of granular systems, collapse of additively-manufactured steel lattices, and spall formation in a magnesium alloy will be highlighted. Specific challenges related to scintillator performance, bunch structure, and visible light collection will also be discussed.

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