

SHOCK13-2013-000499

Abstract for an Invited Paper
for the SHOCK13 Meeting of
the American Physical Society

Dynamic Experiments using IMPULSE at the Advanced Photon Source

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The ability to examine the dynamic response of materials at extreme conditions requires diagnostics that can provide real-time, in situ, spatially resolved measurements at the appropriate length. Recent advances in synchrotron sources and diagnostics coupled to dynamic loading platforms are transforming the dynamic compression field to allow for such investigations. In the current work, recent experimental efforts on the IMPULSE (IMPact System for ULtrafast Synchrotron Experiments) capability at the Advanced Photon Source (Argonne, IL) will be highlighted to describe the development of the capability and its use to examine phenomena including jet-formation in metals, compaction, crack formation and propagation, and material strength and failure. These experimental results have relied in part on: 1) the development of a robust optically multiplexed intensified detector configuration to obtain the first shock movies and 2) gun system improvements to better synchronize the impact event with the 60-ps width X-ray bunch. The IMPULSE capability is expected to continue to reveal novel phenomena for materials subjected to high strain rate loading while developing the required knowledge base to ensure success for future facilities including the Dynamic Compression Sector at the Advanced Photon Source and LANL's MaRIE.