Frontiers of New Light Sources Applied to Materials, Interfaces, and Processing Focus Topic
Room Union Station AB - Session LS-ThP

Frontiers of New Light Sources Applied to Materials, Interfaces, and Processing Poster Session

LS-ThP-1 Bringing Synchrotron Capabilities to a Local X-ray Facility: the Lyncean Compact Light Source*, **Benjamin Hornberger**, J Kasahara, M Gifford,* Lyncean Technologies, Inc.

Synchrotron facilities around the globe are the supercomputers of X-ray science, contributing to many areas of materials science. There are more than fifty synchrotrons worldwide serving more than ten thousand researchers. The light generated by these sources is typically high flux, monochromatic, energy-tunable and, in some cases, coherent. They serve a myriad of applications and thousands of researchers, but they come at a high construction and operating cost and generally require government support. Furthermore, these facilities are oversubscribed by an ever-expanding user base.

Consequently, there is an increasing need for small, locally owned and operated, multi-discipline, X-ray facilities that provide the flux and energy tunability that is required for experiments such as diffraction, spectroscopy, or dynamic imaging.

The Lyncean Compact Light Source (CLS) is the cornerstone of this kind of modern, multi-discipline, and high-performance laboratory. The Lyncean CLS is the first commercially developed X-ray source in its class; it was specifically created to deliver a true home laboratory alternative to many experiments performed today at the large synchrotrons. X-rays are produced in the CLS via inverse Compton scattering through the interaction of low energy electrons (25 to 45 MeV) in a miniature storage ring with a micrometer-period, high powered laser pulse (laser-undulator). Tunable, monochromatic, and high flux undulator synchrotron radiation is generated in the CLS "mini-synchrotron" as a result of the high repetition rate (~65MHz) of this interaction. Characteristics of the CLS X-ray beam are similar to those of a bending magnet synchrotron in terms of flux and coherence, and as such, similar synchrotron quality applications can be performed: imaging/tomography, diffraction, scattering, and spectroscopy.

In this presentation we describe the technology behind the Lyncean Compact Light Source and provide examples of the various measurements that are possible with the system. The broad range of applications served by the Lyncean Compact Light Source illustrates our vision for a new kind of multi-discipline X-ray facility.

LS-ThP-2 Observing Formation of Detonation Nanodiamond at Sub-Microsecond Timescales at the Advanced Photon Source*, **Trevor Willey,** J Hammons, M Bagge-Hansen, M Nielsen, L Lauderbach, R Hodgin, W Shaw, W Bassett, E Stavrou, S Bastea, L Fried, L Leininger,* Lawrence Livermore National Laboratory

Over the past few years, we have developed a capability to perform small-angle x-ray scattering (SAXS) and wide-angle x-ray scattering (WAXS) during high explosive detonation. We can acquire a SAXS or WAXS pattern from individual 80 ps x-ray pulses, which at the APS in 24-bunch mode, arrive every 153.4 ns. We can acquire up to eight frames, from sequential pulses, per event. Various morphologies of carbon condensates appear during detonation, dependent upon the pressure and temperature attained, and liquid, diamond, and graphitic phases can be inferred from the SAXS and WAXS. Transmission electron microscopy of recovered nanoparticles confirms these phases. Nanoparticles, including detonation nanodiamond, form over a few hundred nanoseconds. Here, we present an overview of the capability and a few select results.

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