PURDUE UNIVERSITY

PURDUE MATERIALS ENGINEERING

Materials Engineering Fall 2014 Seminar Series

Monday, October 27th
3:30 pm Coffee
3:45 pm Seminar
ARMS 1010

Multiscale and multimodal x-ray imaging techniques for materials structural characterization

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Seeing is believing. Direct imaging of sample morphology and internal structure has been a key step in modern scientific research. In terms of microscopy, x-ray imaging techniques exhibit unique advantages in studying real materials under real conditions in real time because of the superb penetration power of high-energy photons. Into the twenty-first century, the advent of synchrotron and free-electron laser has stimulated a rapid development in x-ray imaging techniques. With highly coherent and intense x-ray beams, we are now capable of visualizing material microstructures and their dynamic evolution with extremely high spatial and temporal resolutions.

In this seminar, working principles and applications of multiple full-field x-ray imaging techniques will be introduced. These techniques allow *in situ* studies of a broad range of material systems by 2-D and 3-D imaging sample structures with spatial resolutions ranging from a few nanometers to micrometers and temporal resolutions from a hundred of picoseconds to seconds. Two techniques will be particularly highlighted in the talk. One is coherent surface scattering imaging, which can reconstruct not only planar images of surface structures but also 3-D architectures with nanometer resolution along the surface normal direction. The second technique is the simultaneous high-speed x-ray imaging and diffraction, which was recently developed and implemented at the 32-ID-B beamline. Capable of collecting sample information in both real and reciprocal spaces in the sub-nanosecond timescale, this technique is ideal for probing the behaviors of crystalline materials involved in a variety of dynamic processes, such as high-strain-rate loading, laser heating, quenching, and combustion.

Dr. Tao Sun received his bachelor and master degrees from Tsinghua University in China, and his Ph.D. in Materials Science and Engineering from Northwestern University in 2009 (supervised by Prof. Vinayak Dravid). After three years' postdoc research at Argonne (with Dr. Jin Wang and Dr. Murray Gibson), he was appointed to the staff scientist position in 2012. Dr. Sun is now an assistant physicist in the Imaging Group of X-ray Science Division, and cooperates in operating multiple x-ray imaging beamlines. Dr. Sun's research covers a broad range of topics in materials science and x-ray physics. His current research focuses on developing novel synchrotron x-ray imaging and scattering techniques, and on achieving fundamental understanding of some interesting transient phenomena in hard and soft condensed matters.