Materials Science & Engineering Seminar Series

Carnegie Mellon University
Materials Science & Engineering

presents

In Situ Synchrotron X-Ray Study of Additive Manufacturing Process

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ABSTRACT:
Additive manufacturing (AM, *a.k.a.* 3D printing) refers to a suite of disruptive technologies that build three-dimensional objects by adding materials layer by layer based on digital design. In particular, metal AM has developed rapidly in the last three decades and found many applications in the fields of medical, aerospace/aviation, automobile, and defense. Numerous 3D printer manufacturers have emerged, and the technique maturation was seemingly reached. However, in reality, fabrication of defect-free products with precise dimensions remains challenging, and the repeatability and reliability of AM processes are still low.
Synchrotron x-ray techniques are among the most versatile and effective techniques for characterizing materials microstructures and their evolution in various processes and conditions. At the Advanced Photon Source (APS) of Argonne National Laboratory, we recently applied high-speed x-ray imaging and diffraction techniques for *in situ*/*operando* characterization of various metal AM processes. The high-penetration power of high-energy x-rays make it possible to look through dense metallic materials and watch their dynamic structural evolution during the AM process. Many significant phenomena were quantitatively measured with unprecedented high spatial and temporal resolutions, and new understanding were enabled by the direct observation. In the presentation, I will give an overview of the AM research at the APS, and introduce a few scientific cases to highlight the unique capabilities of synchrotron x-ray techniques on studying metal AM processes.

BIOGRAPHY:
Dr. Tao Sun is a Physicist in the X-ray Sciences Division of Argonne National Laboratory, and also a fellow of Northwestern-Argonne Institute of Science and Engineering. Dr. Sun's research is focuses on developing and applying cutting-edge synchrotron x-ray techniques on studying advanced materials and manufacturing processes. He has developed x-ray coherent surface scattering imaging technique for resolving sample surface/interface structures, and high-speed imaging and diffraction techniques for studying highly dynamic, yet non-repeatable and/or irreversible, materials behaviors under extreme conditions. Dr. Sun has published more than 70 scientific papers, and delivered more than 40 invited talks and conference presentations. Dr. Sun obtained his Bachelor and Master degrees from Tsinghua University, and his Ph.D. in Materials Science and Engineering from Northwestern University. He is currently leading multiple DOE projects on additive manufacturing.

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