NextManufacturing
Carnegie Mellon University

Tuesday, November 12, 2019
10:00 – 11:00 am

Scott Hall 6142

Using Synchrotron-based X-ray Techniques to Characterize Porosity Formation in AM Builds with Non-Spherical Powder

Mr. Ziheng (Dino) Wu
PhD Candidate, Materials Science and Engineering

Laser powder bed fusion is a novel manufacturing process that fabricates parts in a layer-by-layer manner using a laser heat source. While this technology advances the manufacturing process in many ways especially enhancing the complexity of the part design, a lot of materials-related puzzles are yet to be understood. Owing to the complex melting sequence, the fast solidification rate and the special feedstock characteristics, some unique internal features are often deposited in the printed material, e.g., porosity, cracks and precipitates, etc. As a result, when compared with traditionally processed material, as-built AM parts exhibit differences in mechanical performance that are essential to understand for many applications. Thus, the ability to observe the formation of such internal features is critical for understanding and optimizing AM processing. Synchrotrons are facilities that generate high energy, high flux X-rays ideal for microstructure characterization. Compared to the lab-scale X-ray devices, synchrotron X-ray sources allow users to capture phenomena on extremely short time scales in situ and to resolve smaller internal features in 3D. We present a general overview of various synchrotron-based X-ray techniques, including tomography, high-speed imaging and diffraction, all of which help us to understand the many phenomena that occur during/after the rapid solidification inherent to metals AM.

3D Nanoparticle Printing to Create the CMU Array, the Next Generation Neural Interface

Ms. Sandra Ritchie
PhD Candidate, Mechanical Engineering

As we seek to increase our understanding of the brain and the associated natural neural networks and intelligence, researchers are limited by the hardware currently available for brain-computer interfaces. Limits in geometry, electrode site density, and customizability of the devices has hindered progress in this area. These limitations are related to traditional silicon-based lithographic methods to create 3D BCI devices. To overcome these limitations, our lab has been exploring the use of 3D nanoparticle printing to create ultra-high density, customizable brain-computer interface called CMU array. Leveraging previous work in the lab which translated aerosol jet printing from a 2D to a fully 3D process, my research is focused on further developing this novel and revolutionary manufacturing processes and creating protocols that will create high-quality devices with tunable geometries as well as desirable structural and electrical properties. Use of well-understood engineering principles combined with in-situ monitoring, both optical and thermal, of the complex process of nanoparticle sintering has enabled scaled-up devices with expanded use for in vivo experiments. Early tests of these devices have been highly encouraging, with longer term biocompatibility testing to be completed soon.