Droplet-based Additive Manufacturing

Abstract
Droplets of liquid solutions and suspensions can be used as building blocks for additive manufacturing. The smallest feature size is determined by the size and uniformity of the original droplets. The role of traditional ink-jet printers in nanomanufacturing is limited by the >10-micron size barrier and the <20cp viscosity barrier. Our research is motivated by the need to overcome these barriers. In the first part of this talk, I will discuss our fundamental study on understanding the instabilities and breakup of liquid microjets. The jet breakup is critical for generating monodisperse micro and nano droplets. For jets without surface charge, the only unstable state is the axisymmetric mode, which is known as varicose instability. For electrified jets, the presence of surface charge enables additional unstable modes, among which the most common one is the whipping instability that bends and stretches the charged jet. I will show the fascinating phenomena of breakup of electrified jets that undergo both varicose and whipping instabilities in a well-controlled fashion. In the second part of this talk I will demonstrate examples of droplet-based additive manufacturing, such as printing ceramic sensors for harsh environments, coating of fluorine polymer with microscopic surface textures for drag reduction, and fabrication of semiconducting polymer nano pillars with superior charge mobility for enhanced solar cell performance.

About the speaker: Dr. Weiwei Deng is an Assistant Professor of Mechanical Engineering at the University of Central Florida (UCF). Prior to joining UCF in 2010, he was a Lecturer and Postdoctoral Associate at Yale University, from where he earned his Ph.D. in Mechanical Engineering. He received his BS and MS in Engineering Mechanics from Tsinghua University. Dr. Deng’s research expertise is experimental fluid dynamics of low-dimensional liquid subjects such as droplets, jets, and films. He is interested in droplet-based additive manufacturing with the focus on using electrospray to process advanced energy materials. Dr. Deng has consulted for ExxonMobil Corporate Strategic Research Center and Applied Materials Inc. Dr. Deng received the Robert Apfel Fellowship Award from Yale. He was named CAE Link Assistant Professorship at UCF. In 2012, Dr. Deng led a student entrepreneur team and won the 1st Place in the Southeast Region of the inaugural National Clean Energy Business Plan Competition. The prize includes $100,000 cash award and a trip to the White House. Dr. Deng is the recipient of the NSF CAREER Award from the Nanomanufacturing Program in 2015.