

Department of Electrical and Computer Engineering

Center for Integrated Bio and Nano Systems

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11:15 a.m. (Refreshments served at 12:15 pm)

Room: CBB 104

# DEFECT-FREE METAL ADDITIVE MANUFACTURING THROUGH PHYSICS-BASED PROCESS MODELS

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**Abstract:** Electron-beam additive manufacturing is a recently developed metal 3D printing process that uses a high-power electron-beam to fuse powder feedstock, layer-by-layer, into bulk objects. Although this form of additive manufacturing offers several key advantages over traditional processing techniques, it still has a number of unresolved issues, including an unacceptably low yield and the fact that the as-printed parts often contain cracks and pores that adversely affect mechanical properties. In this talk, I will present two examples from our research that address these processing issues. First, I will describe a study in which we used in-situ infrared thermography and micro-computed tomography to elucidate how surface-connected pores nucleate and grow during a build. Next, I will present an analytical model of the powder-bed charging that occurs as electrons are injected into the build envelope. I will show how this model can predict parameter sets that lead to excessive charge accumulation and to a related phenomenon known as “smoking”, in which the electrostatic forces acting on the particles grow so large that they drive the particles out of the build envelope. Finally, I will describe new strategies, suggested by these studies, for improving the yield of electron-beam additive manufacturing and for printing higher-quality parts.

**Bio:** Dr. Cordero is an assistant professor of Materials Science and NanoEngineering at Rice University. He earned both his B.S. in Physics and his Ph.D. in Materials Science and Engineering from the Massachusetts Institute of Technology. After receiving his PhD, Dr. Cordero spent one year as a post-doctoral fellow at the Manufacturing Demonstration Facility of the Oak Ridge National Laboratory. There he developed improved process monitoring, quality control, and microstructure design tools for powder-bed, metal additive manufacturing technologies. Dr. Cordero launched the Additive Lab at Rice University in July 2016. For additional information please visit Dr. Cordero’s website: <http://additive.rice.edu/>

Contact Prof. Jiming Bao ([jbao@uh.edu](mailto:jbao@uh.edu)) if you would like to arrange for a time to meet with Dr. Cordero.