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Birck Nanotechnology Center

Nanomanufacturing Preeminent Team Faculty Seminar

Dr. Sebastian Pattinson

Engineering Additive Manufacturing Processes Across Length Scales for Future Wearable and Implantable Devices

Monday, February 19th, 2018
2:00pm – 3:00pm , BRK 1001

Bio: Sebastian Pattinson is a postdoctoral fellow in Mechanical Engineering at MIT using materials chemistry and additive manufacturing to realize new devices and materials whose structure and composition is designed from the molecular to the macroscale to improve interaction with the human body. He received Ph.D. and Masters degrees in the Materials Science Department at the University of Cambridge, where he developed synthesis methods to control the structure and function of carbon nanotubes and hierarchical materials. His awards include a US National Science Foundation postdoctoral fellowship; UK Engineering and Physical Sciences Research Council Doctoral Training Grant; MIT Translational Fellowship; and a (Google) X Moonshot Fellowship. He has also recently won the top prize at both the MIT Mechanical Engineering Research Exhibition and the MIT Materials Day Symposium for his work on additively manufactured mesh.

Abstract: Additive manufacturing could significantly enhance wearable and implantable devices by better mimicking the complexity and diversity of human bodies, yet improved processes and materials are needed to realize this potential. I will discuss two novel additive techniques where molecular and macroscale material properties are engineered to enhance product mechanics and enable new devices. 1) I will describe the first method for additive manufacturing of full-density cellulose objects, which is made possible by reversibly modifying the cellulose molecule. These printed cellulose parts have strength and toughness equal to or greater than common thermoplastics, yet are isotropic due to solvation-based interlayer bonding. Furthermore, we fabricate parts with antimicrobial functionality to demonstrate the versatility of this method, which may make it favorable for manufacturing customized products in many industries where cellulose is already widely used including pharmaceuticals and medical devices. 2) I will present a method for the additive manufacture of meshes whose mechanics and geometry can be tailored to a patient/wearer. By developing novel printer control software and hardware that enables local specification of mesh geometry, connectivity, and material composition, we demonstrate the ability to locally modulate the mechanical response of the mesh to suit different tissues. Through demonstration devices, I will illustrate how these advances may be able to prevent injuries and reduce the significant complications experienced by many millions of people who suffer from diverse soft tissue conditions.

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