Textile Manufacturing of 3D Lattice Materials

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Abstract:

Recent advances in topological optimization methodologies for design of internal material architecture, coupled with the emergence of micro- and nanoscale fabrication processes, 3D imaging, and micron scale testing methodologies, now make it possible to design, fabricate, and characterize lattice materials with unprecedented control. This talk will describe a collaborative effort that employs scalable 3D textile manufacturing, location specific joining, and vapor phase alloying to produce metallic lattices with a wide range of internal architectures, alloy compositions, and mechanical and functional properties. Topology optimization allows properties to be decoupled and tailored for specific applications. Dramatic enhancements in permeability have been balanced with modest reductions in stiffness, and are being used to develop heat exchanger materials with high thermal transport, low impedance, low thermal gradients and high temperature strength. In a parallel effort, architectural designs to maximize both structural resonance and inter-wire friction are also being employed to develop metallic lattices capable of mechanical damping at elevated temperatures. These examples will be used to highlight the benefits to be gained by the design, manufacturing and characterization of metallic lattice materials with a wide range of tailorable properties.

Bio:

Kevin Hemker is the Alonzo G. Decker Chair of Mechanical Engineering and is currently a Professor in the Department of Mechanical Engineering at Johns Hopkins University, with joint appointments in the Departments of Materials Science & Engineering and Earth & Planetary Sciences. He holds a BS in metallurgy from the University of Cincinnati (1985), MS and PhD degrees in materials science and engineering from Stanford University (1990), and completed a postdoctoral fellowship in physics at the Ecole Polytechnique Federale de Lausanne. He is a former editor of Scripta Materialia, former member of the TMS Board of Directors, a Fellow of ASME, ASM and TMS, and a member of the DARPA Defense Sciences Research Council (DSRC).
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