The Materials Science & Engineering Program Presents

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Ultralight Microlattices Fabricated from Self-Propagating Photopolymer Waveguides

Microlattice materials with periodic cellular architecture were fabricated using a new process that enables precise control over architecture at three levels of hierarchy at three distinct length scales. Lattice unit cell (~mm-cm), hollow tube lattice member (~µm – mm) and hollow tube wall thickness (~nm - µm) can be controlled independently, enabling the design of micro-lattice materials with tailored properties. The fabrication process is based on an interconnected array of self-propagating photopolymer waveguides, enabling rapid and scalable manufacturing. The resulting polymer microlattices can then be coated with a variety of techniques to capture their architecture in other materials, such as metals and ceramics. By electroless nickel plating and subsequent polymer removal we have achieved hollow tube microlattices with wall thicknesses <100 nm, resulting in densities as low as 0.9 mg/cc, lower than any other material ever reported. This unique hierarchical architecture also results in unprecedented mechanical behavior: complete recovery after compression exceeding 50% strain and energy absorption similar to elastomers. Our results demonstrate how design of an ordered cellular architecture can facilitate creation of materials with unmatched low densities and mechanical properties, redefining the limits of lightweight materials.

Bio: Dr. Tobias A. Schaedler is a Research Staff Scientist in the Architected Materials Department at HRL Laboratories, LLC (formerly Hughes Research Labs). After receiving his Ph.D. in Materials from the University of California in Santa Barbara, he worked at General Electric Aviation for several years. He is the lead author of a publication on ultralight metallic microlattices that appeared in Science (334, p.962) a year ago and garnered international media attention.

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