Designer Materials

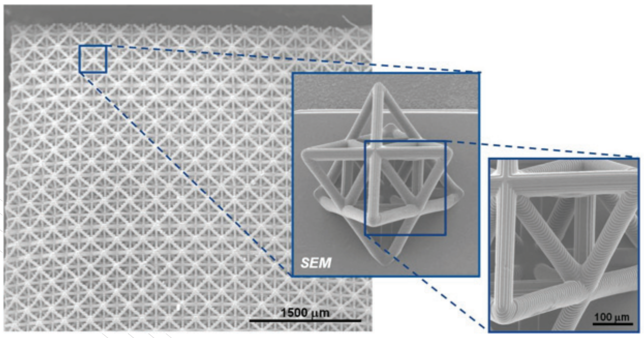
A material's properties and overall performance are determined by its chemical composition, crystalline state, and underlying micro-architecture. These characteristics force engineers to accept certain trade-offs when choosing a material for a specific application. This concession made by engineers may soon be a thing of the past because of Livermore-developed manufacturing practices that can produce designer materials with previously unattainable properties.

Additive manufacturing is the process of building 3D structures by sequentially layering one material on top of another in a desired pattern. Unlike conventional fabrication methods that require etching or machining, additive manufacturing enables materials to be built from the inside out with extreme precision. Laboratory materials scientists and engineers and partner researchers have developed prototype additive micro-manufacturing equipment to fabricate 3D micro-architectures with submicrometer features. By controlling the micro-architecture of a material, its properties can be altered to defy conventional behaviors. As an example, the density and stiffness of a material are linked such that the denser a material is, the stiffer it is. Using the new techniques, these properties can be decoupled, and separately controlled on a microscale, to produce highly stiff, low-density material structures.

By enabling the manufacture of 3D micro-architecture materials with novel properties, Livermore researchers are pushing the limits of additive manufacturing and material design and paving the way for a new generation of transformative products and applications.

Photo Credit: CRUX Product Design

(above) Prototype helmets produced using additive manufacturing techniques are a prime application for designer materials. (below) This microlattice structure features high stiffness and low density.



Designer Materials

LLNL research areas include development of the following:

- Extremely lightweight, very stiff materials
- Materials that maintain their shape when heated or cooled
- Durable materials with low radar signature
- Armor materials with 1/10th the weight

This work performed under the auspices of the U.S. Department of Energy by Lawrence Livermore National Laboratory under Contract DE-AC52-07NA27344.

Lawrence Livermore National Laboratory