

## MECHANICAL METAMATERIALS

Mechanical properties of materials can be tailored by material composition but also by geometrical design. The field of mechanical metamaterials aims at exploiting exactly this twofold design freedom. Nanoscribe's Photonic Professional GT offers three-dimensionality (3D), submicron feature size and resolution as well as hierarchical structuring capability. Auxetics and mechanical cloaks are successfully demonstrated by polymeric structures. By subsequent post-processes such as surface coating or electro-plating, damage-tolerant lightweight materials are also made of composites, metals and ceramics.

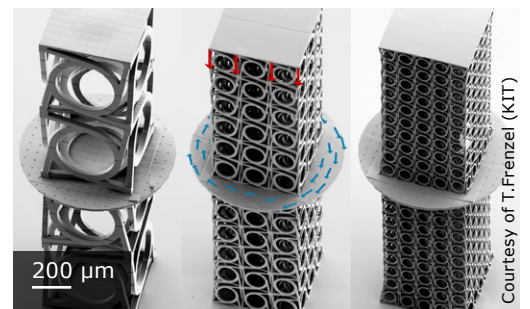


### CHIRAL MECHANICAL METAMATERIAL

**Challenge:** Examine non-Cauchy elastic metamaterials that can respond to compression with a twisting motion (instead of buckling/bending).

**Solution:** Scaling behavior is studied on several, easily printed samples with identical overall dimensions but consisting of different numbers of unit cells.

**Source:** DOI: 10.1126/science.aao4640

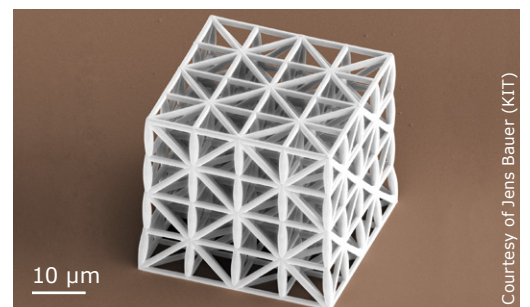


### HIGH-STRENGTH CERAMIC POLYMER COMPOSITE

**Challenge:** Fabrication of a 3D cellular material with low filling factor built of submicron elements demonstrating size-dependent strengthening effects.

**Solution:** 3D polymeric structures with submicron feature size are printed. Ceramic composites are then obtained by subsequent ALD coating with alumina.

**Source:** DOI: 10.1073/pnas.1315147111

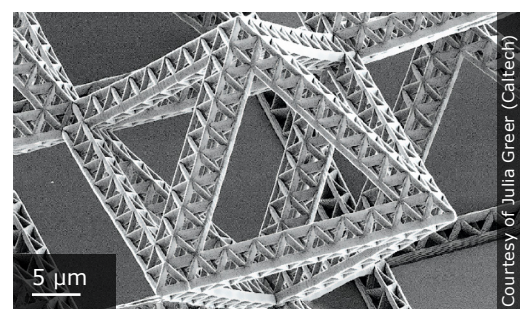


### RESILIENT 3D HIERARCHICAL METAMATERIAL

**Challenge:** Manufacturing of 3D fractal-like architectures with features in the sub-micron regime for the attainment of various mechanical properties, e.g. ultralightweight, recoverability.

**Solution:** 3D hierarchical nanolattices with individual beams comprised of multiple self-similar unit cells with length scales spanning over four orders of magnitude are fabricated.

**Source:** DOI: 10.1073/pnas.1509120112

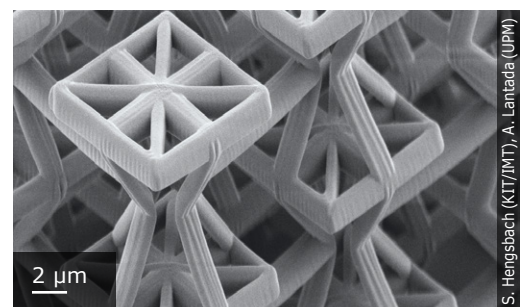


### AUXETICS / NEGATIVE POISSON RATIO MATERIAL

**Challenge:** Micro-manufacturing of a material that laterally expands when stretched and shrinks when compressed, for applications in biomimetics or magneto-mechanical microsystems.

**Solution:** 3D complex geometries with submicron details are fabricated precisely, reproducibly and mechanically stably.

**Source:** DOI: 10.1088/0964-1726/23/8/085033



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