Knowledge Transfer Office
香港城市大學
City University of Hong Kong

Lightweight, High Toughness Metallic Micro Lattice Metamaterials

Manufacturing

Biomedical and Genetic Engineering

Buildings and Construction Technology

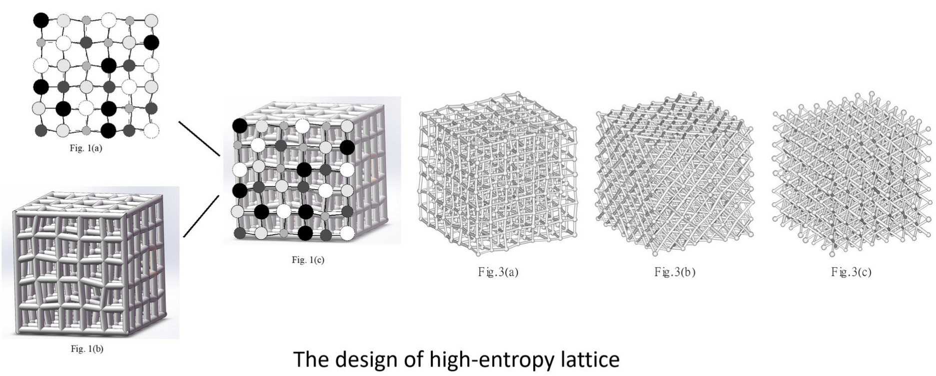
Energy Conservation/Generation/Management/Storage (Battery)

Nanotechnology and New Materials

Robotics

Testing Instruments

Sensors



The design of high-entropy lattice

IP Status

Patent filed

Technology Readiness Level (TRL) 7

Inventor(s)

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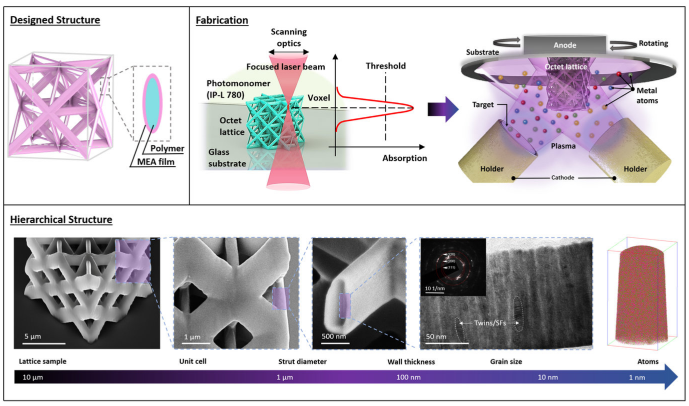
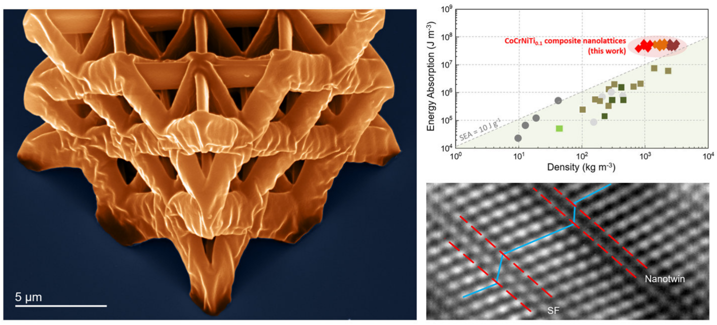


micro scale metallic MEA lattice



The comparison of energy absorption performance

Metal thin film coating combined with high-resolution 3D printing technology.

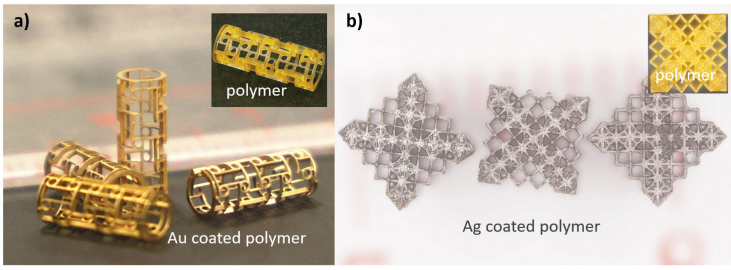


Figure Samples of noble metal applied on high-resolution 3D printed polymer structures. a) Precise Negative Poisson Ratio structured polymer stent with Au thin film; b) High-resolution polymer metamaterial with Ag thin film

Opportunity

Metallic lattice metamaterials represent part of a new paradigm in materials where the properties of metals/alloys are combined with the concept of architecture to produce lightweight materials with properties that are otherwise unattainable with conventional materials. Particularly, this technology combines lattice metamaterials and the emerging multicomponent alloys such as high entropy alloys (HEAs) that possess highly tunable compositions and unique microstructures. This technology has the potential to produce robust materials that are not only lightweight, strong, and ductile, but could also recover to its original geometry upon severe deformation. Furthermore, its excellent properties could extend beyond mechanical properties, and could be tailored to exhibit exceptional functional properties such as high corrosion resistance, biocompatibility, and catalytic performance. These unique properties are highly desired for applications across multiple fields such as aerospace, automation, construction, biomedical, electrochemistry, microelectronics, and robotics.

Technology

Through a CAD software, each unit cell is designed with slight differences and arranged randomly or pseudo randomly to form high-entropy lattice structures. Following optimization, the fabrication of different scale HEA lattice structures is completed with vat photopolymerization-based 3Dprinting machines. The fabricated structures could be further coated with a thin layer of metallic/HEA film to impart functionality enhance mechanical properties (e.g. stiffness, strength, and energy absorption). Optimizing the geometry of the fabricated structures and the metal alloy composition by design and simulation could be done to manipulate the mechanical properties and deformation mechanism of the fabricated structures more precisely. Further works to employ more complex structures with unique behaviors and characterize them across multiple length scales (from macro-scale to the atomic-scale) through advanced methods such as digital image correlation (DIC), finite-element modelling (FEM), scanning electron microscopy (SEM), transmission electron microscopy (TEM), and atomic probe tomography (APT) are currently underway.

Advantages

- Superior high strength and ductility
- Strong corrosion resistance
- Improved energy absorption
- Biocompatibility and High catalytic performance
- High precision and large breadth

Applications

- Functional materials for electronic devices or energy storage
- Bio-scaffolds for cell culturing
- Automotive components and Aerospace parts