# REU Site: Engineering research in a liberal arts and entrepreneurship context

## 3D Printing Technologies

## Mentor: Prof. Tengteng Tang

**3D Printing Interpenetrated Metal-Polymer Metastructure with High Strength, Impact Resistance, and Energy Absorption Efficiency:**

This project focuses on lightweight interpenetrated metal–polymer metastructures for next-generation protective and structural applications. These architected materials combine the flexibility of polymers with the strength of metals to achieve exceptional stiffness, impact resistance, and energy absorption efficiency. Using stereolithography (SLA)-based 3D printing integrated with conductive coating and electrodeposition, we can precisely control the geometry and material distribution to create hybrid lattices with tunable mechanical performance. This approach enables the fabrication of multifunctional materials that overcome the limitations of conventional cellular structures, such as localized deformation and catastrophic failure underload.

Students involved in this project will gain hands-on experience in multi-material additive manufacturing, electrochemical processing, and mechanical characterization through compression, bending, and impact testing. The work provides valuable exposure to advanced materials design and experimental mechanics with real-world applications in aerospace, robotics, and wearable protection systems.

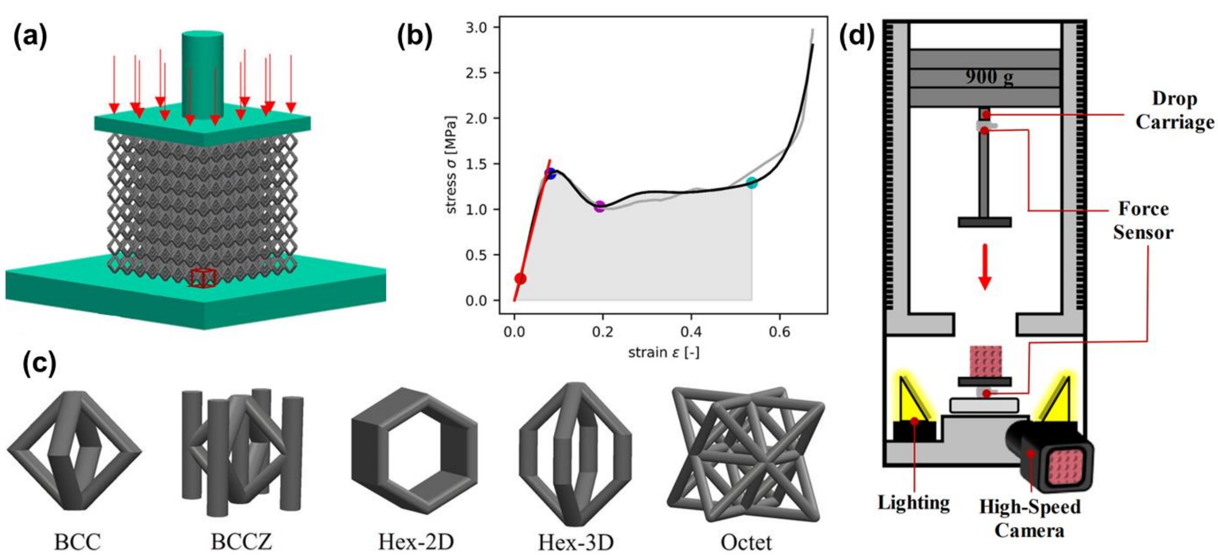


Figure 1. The illustration of compression and dropping test on various metastructures.

**3D Printing Polarizer for Optical Steganography:**

This project focuses on 3D printing translucent resin-based polarizers for optical steganography—a novel approach to secure data storage and optical communication. Traditional data storage methods rely on electronic or magnetic systems, while this project explores light-based data encoding using 3D-printed optical materials. By leveraging vat photopolymerization (VPP), an additive manufacturing technique that cures liquid photopolymers layer by layer with UV light, we aim to fabricate polarizers with precisely controlled anisotropic properties. Through optimization of geometric design, photopolymerization parameters, and layer-stacking interfaces, the research seeks to manipulate polarization behavior at the voxel level, enabling hidden optical information to be encoded and decoded within translucent structures. This interdisciplinary effort advances the frontiers of additive manufacturing, materials science, and optical engineering, with potential applications in data security, diagnostics, and display technologies. Students participating in this project will gain experience in 3D printing, optical testing, and materials characterization, contributing to the development of next-generation optical devices.

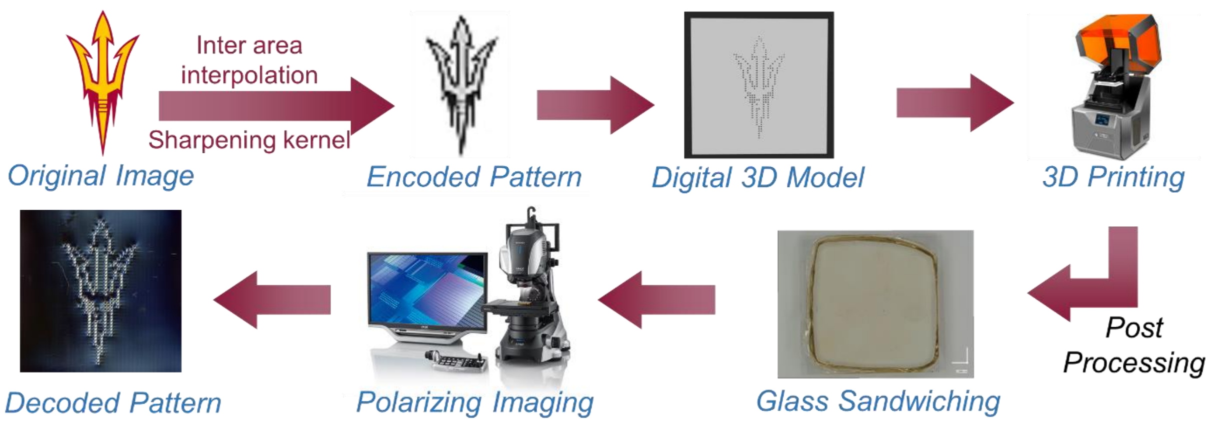


Figure 2. The workflow from pattern encoding, fabrication, to decoding.

[Learn more about Prof. Tengteng Tang]