National Aeronautics and Space Administration

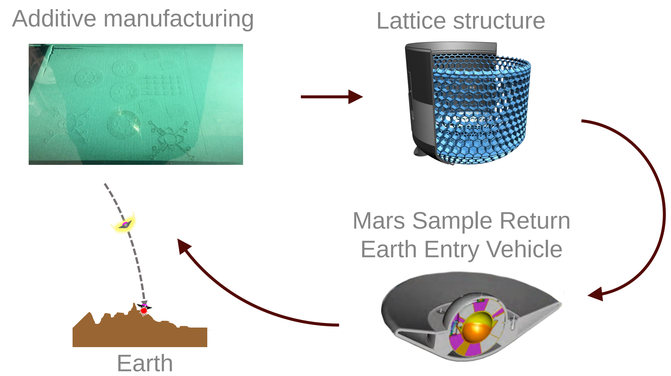
Tunable Additively-Manufactured Impact Attenuation System for Entry, Descent, and Landing

Principal Investigator: Ryan Watkins (357); Co-Investigators: Adam Duran (355), Eleni Comstock (352), Marcello Gori (352), Robert Crocco (174), Morgan Hendry (352), Samad Firdosy (357), Andre Pate (357)

Program: FY21 R&TD Topics **Strategic Focus Area: Additive Manufacturing, Multifunctional Systems**

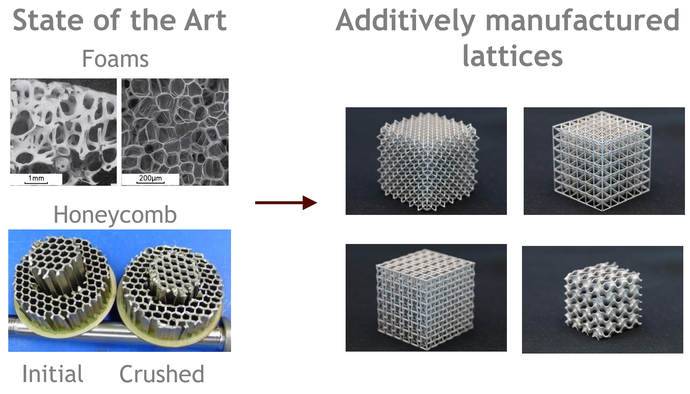
Objectives

The objectives of this work were to reduce the mass, cost, and manufacturing schedule of impact attenuation systems for Entry, Descent, and Landing (EDL) applications through the implementation of spatially varying 3D printed lattice structures



Background

Additively-manufactured lattices generalize the concept of conventional honeycombs/foams, vastly increasing the design space and capabilities of EDL impact attenuation systems



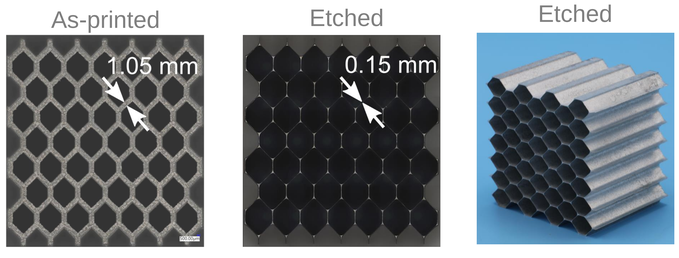
Significance/Benefits to JPL and NASA

Broad applications relevant to current (ex. MSR) and potential future missions (ex. Europa Lander)

- Increased design flexibility: ↓mass
- New application spaces: ↓mass
- Conformal geometry: ↓mass, ↓cost, ↓schedule
- Rapid prototyping: ↓cost, ↓schedule

Approach and Results

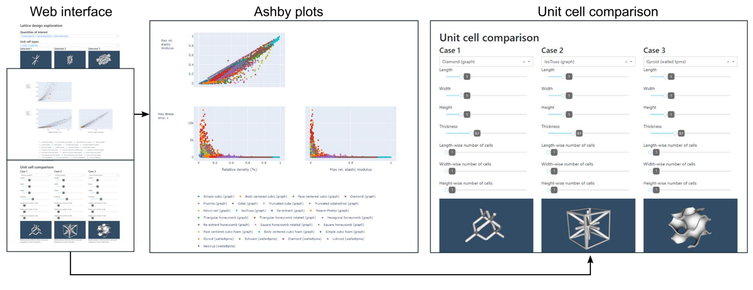
Chemical etching



↓50% surface roughness , ↓75% relative density ($\tilde{\rho}$)

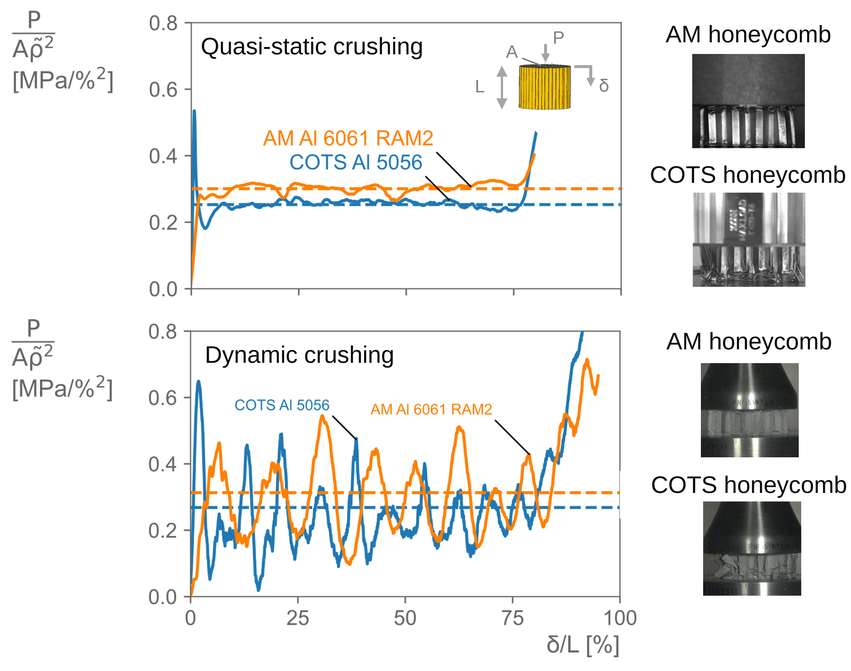
Developed a novel chemical etching process to enhance mechanical performance and achieve low relative densities.

Web-based design tool



Developed a web-based design tool, based on simulation data from over 10,000 unit cell geometries, to enable engineers to select the appropriate lattice unit cell for their specific application

Crush testing



Demonstrated 15% improvement in crush strength and energy absorption efficiency (quasi-static and dynamic) in comparison to Commercially-Off-The-Shelf (COTS) honeycombs

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Jet Propulsion Laboratory
California Institute of Technology
Pasadena, California

www.nasa.gov

PI/Task Mgr Contact
Email: Ryan.T.Watkins@jpl.nasa.gov

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