National Aeronautics and
Space Administration

Lattice Block and Metallic Foam Materials

For lighter weight structures with improved strength, impact resistance, and noise reduction

TECHNOLOGY OPPORTUNITY

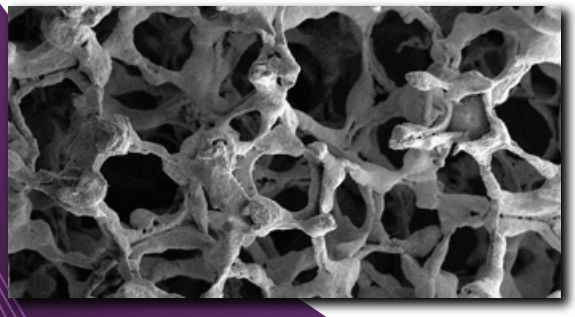
NASA's Glenn Research Center invites companies to establish partnerships to explore new applications for lattice block and/or metallic foam materials. Lattice block structures represent a significant advance in the state-of-the art of lightweight engineered structural components due to their ability to reduce weight while maintaining stiffness and strength. Metallic foam provides excellent impact resistance and noise suppression and can withstand high heat and extreme temperature variations. Originally developed for aerospace, these technologies have the capability to significantly enhance the performance of automotive components and systems.

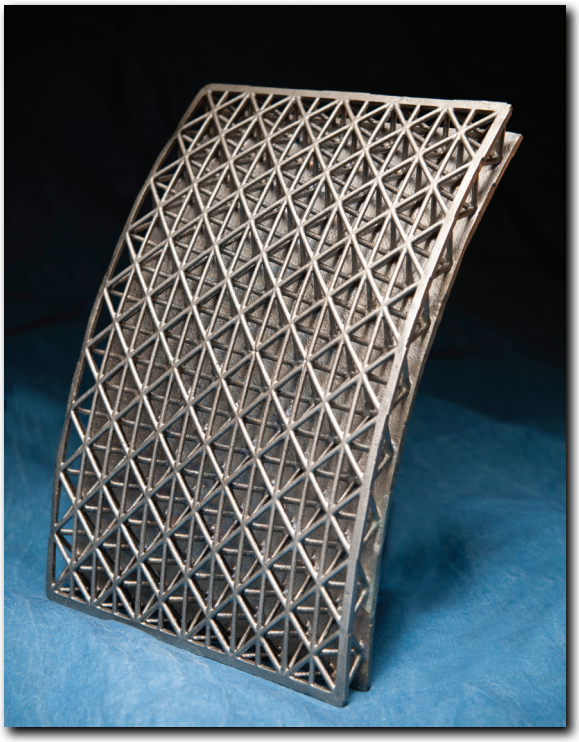
BENEFITS

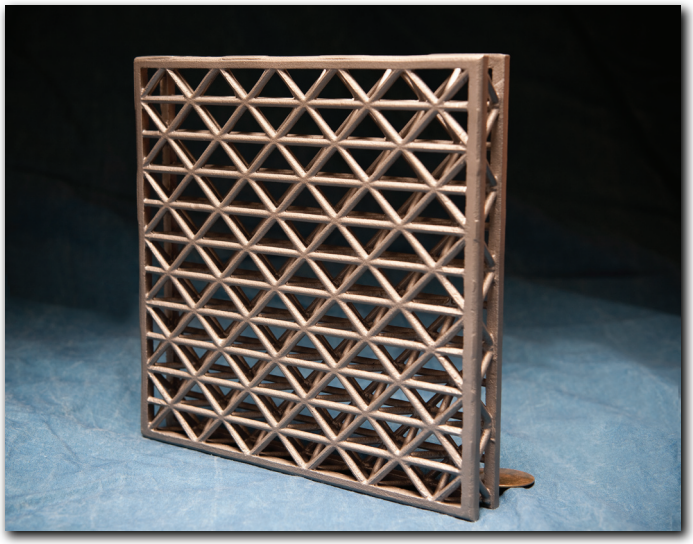
- **Versatile:** Lattice structure can be applied to any material, including aluminum, steel, nickel superalloys, fiber-reinforced composites, etc., whereas honeycomb can only be fabricated from alloys that can be rolled
- **Lightweight:** A lattice block 15- by 25-cm IN718 casting with 1.5-mm-diameter ligaments achieves 85 percent weight savings over a solid IN718 of the same dimension
- **Durable:** These materials can withstand high heat and temperature variations
- **Lattice block structure** is ductile and defect tolerant
- **Metallic foams** provide high impact resistance and excellent acoustic absorption

TECHNOLOGY DETAILS

Lattice block materials are manufactured into a lightweight truss structure similar to trusses on a highway bridge, but on a centimeter scale. The sandwich structure encases a lightweight metallic foam core, which provides structural strength and significant weight savings. The foam core decreases overall density, enhances stiffness, and increases structural and acoustic damping. The open structures permit cooling, acoustic absorption, and other multifunctional design advantages.



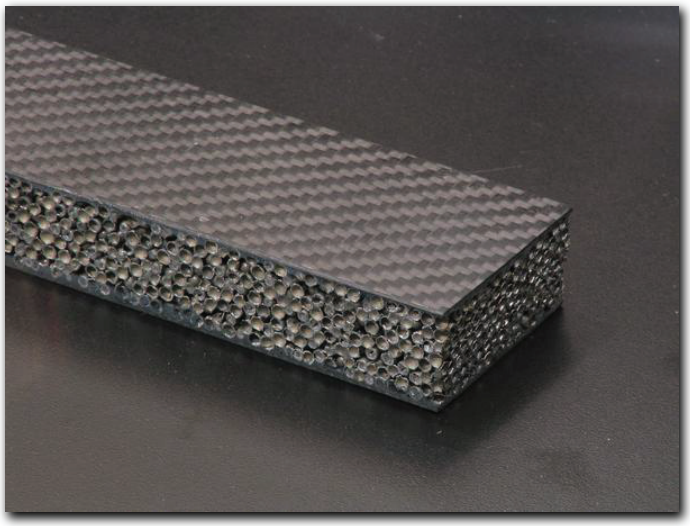




HOW IT WORKS

Lattice block materials are formed using three-dimensional printing and investment casting processes. Casting allows the part to be cast to size, avoiding the need for extensive thermomechanical processing and joining. The resulting structure is both redundant in overload and defect tolerant in fatigue.

Metallic foams are stiffer than polymer foams, extremely fire resistant, and fully recyclable (reducing their carbon footprint), and they do not generate toxic fumes at high temperatures. Because metallic foams use powder metallurgy, they are inexpensive to cast (as compared to casting of other hollow parts). Due to their intrinsic characteristics, metallic foams have high energy absorption, low thermal conductivity, and low magnetic permeability and are highly effective at noise suppression, especially in comparison to lightweight hollow parts.



WHY IT IS BETTER

Lattice block and metallic foams reduce overall weight by replacing individual structures that perform single functions. Lattice block structures significantly increase damage tolerance with low to moderate fabrication costs (depending on material type). They provide excellent strength and stiffness, with just 15 percent of the density of a similarly sized solid plate. Due to the three-dimensional printing and investment casting processes, more intricate and complex structures can be fabricated, and these exhibit significantly higher energy absorption and stiffness/strength.

In comparison to polymers that are presently being used in automobiles, metallic foams are stiffer, stronger, and more energy absorbent. These foams are also more fire resistant and more climate resistant (whereas polymers are more prone to deteriorate in ultraviolet (UV) light, humidity, and temperature extremes). Furthermore, use of metallic foams in hollow parts of the car will significantly reduce noise and strengthen a vehicle's weak points to enhance driver safety.

CAPABILITIES

Glenn Research Center is one of the leaders in testing and evaluation of structural materials as well as structural analysis tools for component design and analysis. Glenn innovators have fabricated and tested multiple lattice block patterns and metallic foam structures and honed the materials for use in aerospace and nonaerospace applications.

LICENSING AND PARTNERING OPPORTUNITIES

Glenn's Office of Technology Partnerships and Planning seeks to transfer technology to and from NASA to benefit the space program and U.S. industry. NASA invites companies to partner with Glenn on lattice block and metallic foam structure materials for nonaerospace applications.

FOR MORE INFORMATION

For more information about this and other technology licensing opportunities, please contact

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