

Cellular Materials

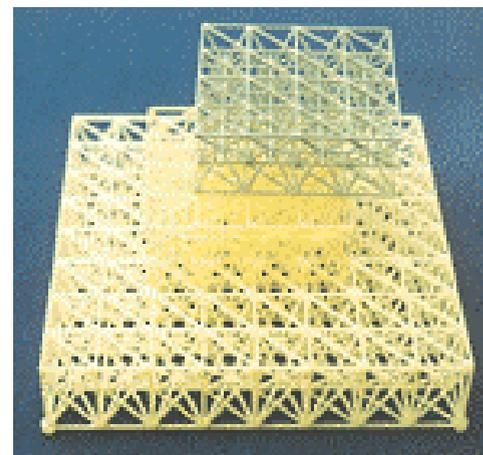
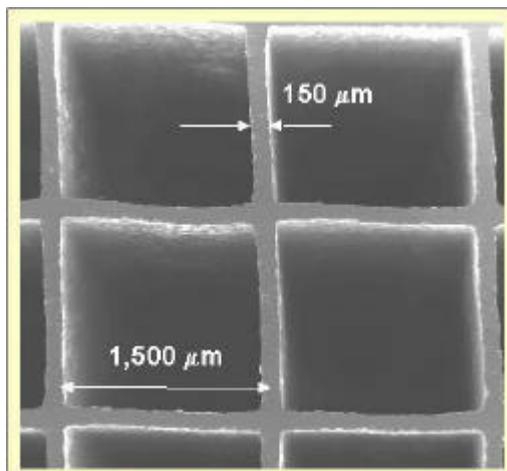
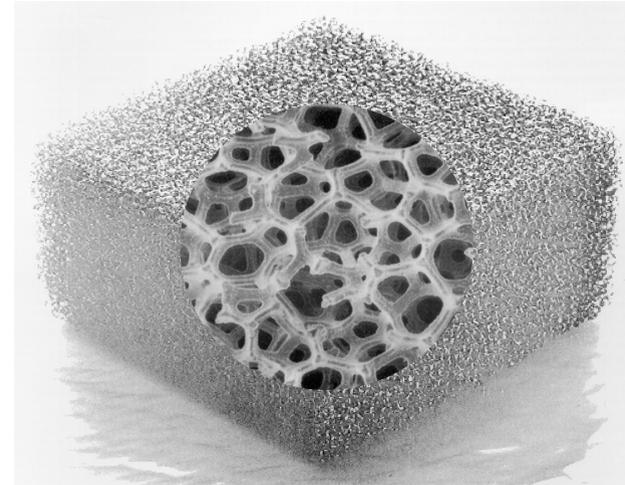


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Outline

- **Cellular Materials**
- **ONR Program, SHORT Summary**
- **Thermal Management Advantages**
- **Opportunities in Macro-Thermal Management**
- **Future Directions in Miniature Thermal Management**
- **Novel Processing Interests**

EXAMPLES OF OPEN AND CLOSED CELLULAR STRUCTURES

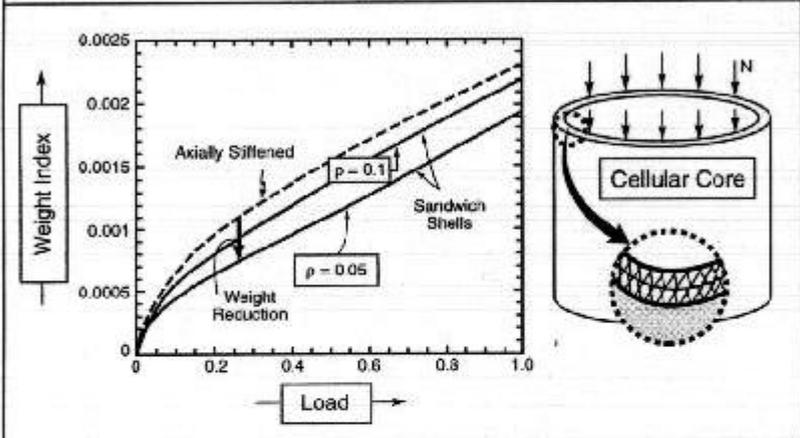




ULTRALIGHT METALS
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ULTRALIGHT SANDWICH SHELLS



MULTIFUNCTIONAL IMPLEMENTATION STRATEGIES FOR CELLULAR METALS

- Lightweight Vehicles (JAV, LV)
 - Lightweight/Fire Retardant Super Structure
 - Blast/Impact Protection Systems
 - Compact High Flux Cooling Systems (Motor Drives, FEBB, TPS; Heat Exchangers)
 - Vibration/Noise Suppression Systems
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- The diagram shows an 'Explosion' represented by a sphere with radiating lines. An 'Impulse, I(x)' is applied to a 'Foam' layer. Below the foam is a 'Buffer Plate', and below that is the 'Structure'. Arrows indicate the direction of the impulse and the flow of foam.

TECHNICAL APPROACHES

- Identify Multifunctional Opportunities
- Create Mechanism-Based Performance and Life Models
- Provide Numerical Implementation Codes
- Establish Test/Analysis Protocols
- Create Novel, High Performance Materials
- Apply Technical Cost Models/Utility Analysis
- Devise Industry Implementation And Feedback Mechanisms
- Create Network To International Programs

ACCOMPLISHMENTS

- Multifunctional Design Manual (Version 4)*
- FEM Design Code*
- Thermal Optimization Code*
- Sandwich Panel Implementation Methodology*
- Case Studies (Blast Protection, Cooling, etc.)
- Cost Models And Utility Analysis*
- Characterization Methodologies (IR, CAT-Scan)
- Novel Materials (Hollow Sphere, Lattice Block)
- Non-Destructive Probes

* Transferred to Industry