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Reference: Syntactic Foam

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Reference

R. Jhaver, H. Tippur. *Materials Science and Engineering A*. 499 (2009), 507–517. ([pdf](#))

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Strong, Lightweight Structural Foam

Overview

Syntactic foams are widely used in structural, marine and automotive applications. They demonstrate good compression response, energy absorption and impact resistance while reducing the overall weight. This invention is an improved syntactic foam called Interpenetrating Phase Composite (IPC) foam. IPC foam shows superior characteristics to conventional syntactic foams, with weight similar to epoxy syntactic foams but strength properties comparable to metal syntactic foams. The IPC foam may have applications as a buoyancy aid for naval and marine applications (including deep-sea drilling equipment), in weight reduction for aerospace and ground transportation vehicles, and in gas pipelines and sports equipment.

Advantages

- Lighter than metal syntactic foams (density less than that of water)
- Higher elastic modulus (28-35% better) than epoxy syntactic foam
- Higher compressive strength (20-25% better) than epoxy syntactic foam, and comparable to many metallic syntactic foams.
- Higher plateau stress (37-42% better) than epoxy syntactic foam
- Enhanced specific energy absorption capacity (50% higher energy absorption per unit volume and 33% higher energy absorption per unit mass) than epoxy syntactic foam

Taken together, these properties allow for improved strength over epoxy syntactic foams, yet at a lighter weight than metal syntactic foams. Thus higher performing materials can be produced for applications where lightweight (including buoyant) properties are desired.

Description

The process of making syntactic foam involves mixing glass microballoons in a matrix typically consisting of epoxy or metal. This allows the foam to have many of the properties of the matrix material but with significantly reduced weight due to the microballoons. In the past, there has been a trade-off between weight and strength when choosing between epoxy-based (lightweight) or metal-based (strong) syntactic foams.

To make IPC, an open-cell aluminum scaffold is slowly lowered into uncured epoxy syntactic foam. The foam fills the pores in the aluminum network, which serves as a permanent framework. The resulting foam has increased strength provided by the aluminum scaffold, yet has a significantly reduced weight compared to metal foams. The IPC foam can be machined or shaped to required dimensions.

Different varieties of IPC foam may be prepared by varying the amount of microballoons in the matrix. Experiments show a significant increase in elastic modulus, yield stress and energy absorption in IPC when compared to conventional epoxy syntactic foam. In addition, pre-coating the aluminum network with silane further improves these properties. IPC foam density is significantly below that of conventional metal syntactic foams, and several of the properties remain comparable or even superior to those foams.

Status

- A patent application has been filed
- This material has been produced and characterized in the lab

Licensing Opportunities

- This technology is available for exclusive or non-exclusive licensing
- Joint development opportunities include funded research or collaboration