Forming Syntactic Foams Using Selective Laser Sintering

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The Wisconsin Alumni Research Foundation is seeking commercial partners interested in enhanced methods for producing syntactic foams. By incorporating hollow particles into an additive manufacturing technique, this low-cost, readily scalable solution produces highly customizable foam products with an extensive range of applications.

Overview

Composite materials are used in the aerospace, automotive, marine and defense industries because of their enhanced specific mechanical properties and functionality. One category of composite materials includes syntactic foams formed from hollow, thin-walled particles blended within continuous polymeric, metallic or ceramic matrices. Syntactic foams possess improved properties like specific impact strength and toughness for certain applications when compared to their solid counterparts.

As of 2022, most syntactic foams are generated using injection molding, but there is growing interest in using techniques like selective laser sintering (SLS) to produce syntactic foams. SLS is a powder-based additive manufacturing technique used to manufacture 3-D parts by sintering polymer powder, and use of SLS to generate foams has been limited by unwanted matrix segregation when using common thermoplastics. Foaming by incorporation of hollow particles, such as glass micro-balloons (GMBs) or hollow micro-balloons (e.g., fly ash cenospheres), into thermoplastics can result in improved properties of the foam, and UW-Madison researchers are exploring the use of hollow particles in combination with additive manufacturing approaches.

The Invention

UW-Madison researchers have developed a new technique that blends an additive manufacturing method – selective laser sintering (SLS) – with hollow particles (e.g., glass micro-balloons (GMBs), fly ash cenospheres, etc.) to create syntactic foams. This is a bottom-up approach for fabricating multiscale flexible syntactic foamed thermoplastics.

Their method leverages a thermoplastic resin containing hollow particles, in this case GMBs, which serves as a compatible foaming agent. The researchers found that coupling hollow particle parameters (e.g., size and type) with SLS print parameters (e.g., laser energy and print time) enabled the fabrication of 3-D printed syntactic foamed thermoplastics with desirable properties (e.g., tuned porosity and density). A suitable combination of these parameters overcomes the limitations of traditional SLS-generated foams (i.e., unwanted matrix segregation, resulting in compromised material properties).

This technique can be used in the production of highly customizable and lightweight materials, including helmets or armor having improved fit, comfort, airflow, and safety. Further, the materials and process are low cost and could be readily scaled and integrated into commercial manufacturing processes.

Applications

- Developing and designing lightweight structures for use in recreation, marine and aerospace industries
- Creating highly customized shapes with specific parameters and applications

Key Benefits

- Can create customized syntactic foam for specific or broad applications
- Low-cost materials
- Method is readily scalable.
- Syntactic foams result in more sustainable, lighter and less expensive components for a variety of commodity and engineering applications.

Stage of Development

The researchers have successfully fabricated foamed thermoplastics using SLS. They characterized the resultant materials and have shown that their process can be used to create highly customized shapes.

Additional Information

For More Information About the Inventors

- Pavana Prabhakar

Publications

- Tewani, H., Hinaus, M., Talukdar, M., Sone, H., & Prabhakar, P. (2022). Architected syntactic foams: a tale of additive manufacturing and reinforcement parameters.

Tech Fields

- Engineering : Additive manufacturing
- Materials & Chemicals : Composites

For current licensing status, please contact Michael Carey at mcarey@warf.org or 608-960-9867