Devices and Methods for 3D Printing of Highly Ordered Composite Materials

Tech ID: 24937 / UC Case 2015-433-0

BACKGROUND

The ability to pattern and control orientation of particles / reinforcements in composite materials is important for maximizing performance measures, such as strength and energy absorption, or adding functionality, such as electrical conductivity. However, current techniques for additively manufacturing two-phase materials lack the ability to carefully pattern particles within the composite, which negatively impacts the final product. For example, the use of stiff particles embedded in a softer matrix material can facilitate material properties that overcome traditional trade-offs between strength, weight and energy dispersion.

DESCRIPTION

Researchers at UC Santa Barbara have created a technique for the precise and tunable ordering of particles in composite materials during direct-write deposition. The process includes a method known as acoustophoresis, where standing pressure waves in fluid-filled channels are used to spatially manipulate particles in solution. In 3D-printing / additive manufacturing applications, acoustically excited nozzles create paths for rapid particle transport while maintaining particle ordering; enabling control over a wide range of two-phase material microstructures. Moreover, this technique can greatly lower the likelihood of nozzle clogging and particle jamming by concentrating particles immediately prior to their ejection from the printing nozzle. Printers are able to deliver inks with a high density of particles, which enables printing materials with higher particle concentrations than that afforded by traditional direct-write techniques. Additionally, the use of acoustophoretic ordering relies only on the magnitude of the primary focusing force generated, which allows for greater flexibility of particle and solvent combinations.

ADVANTAGES

- Reduced clogging and particle jamming in 3D printer nozzles
- Less waste material
- Tunable material properties along the geometry of the component
- Expanded ink material options
- Enhanced functionality of printed components (e.g., conductivity)

APPLICATIONS

- Slip casting for ceramic materials

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OTHER INFORMATION

KEYWORDS

3d printing, additive manufacturing, composites, acoustophoresis, indadvmat

CATEGORIZED AS

- **Materials & Chemicals**
  - Composites

RELATED CASES

2015-433-0

- High-density films for gas-tight electrode layers in solid oxide fuel cells
- Coatings and armor
- Multifunctional materials
- Batteries

RELATED MATERIALS

- Deposition of ordered two-phase materials using microfluidic print nozzles with acoustic focusing - 04/23/2016

PATENT STATUS

Country	Type	Number	Dated	Case
United States Of America	Issued Patent	11,806,929	11/07/2023	2015-433
United States Of America	Issued Patent	11,548,222	01/10/2023	2015-433

ADDITIONAL TECHNOLOGIES BY THESE INVENTORS

- Frequency-Based Filtering of Mechanical Actuation

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