Devices and Methods for 3D Printing of Highly Ordered Composite Materials
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BRIEF DESCRIPTION
A synthesis technique for the precise and tunable ordering of anisotropic particles in composite materials.

BACKGROUND
Additive manufacturing, also known as 3D printing, is a relatively new field where the materials available for printing are rapidly expanding beyond traditional monolithic plastics. For structural materials, the ability to pattern and control fiber orientation in composites, for example, is important for maximizing performance measures such as strength and energy absorption. However, current 3D-printing techniques using two-phase materials lack the ability to carefully pattern particles within the composite, leading to limited performance of the resulting products. The use of stiff particles embedded in a softer matrix material can lead to material properties that overcome traditional trade-offs between strength, weight and energy dispersion.

DESCRIPTION
Researchers at UC Santa Barbara have created a synthesis technique for the precise and tunable ordering of anisotropic particles in composite materials. 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 applications, acoustically excited channels create paths for quick particle transport while maintaining ordering, which provides a novel and attractive way to control a wide range of two-phase material microstructures. By manipulating the amount of acoustic energy delivered to the device, the level of ordering of particles within the microchannel is greatly controlled. Particles are concentrated immediately prior to their ejection through the printing nozzle, which greatly lowers the likelihood of clogging and particle jamming. Printers are able to deliver inks with a high density of particles, which reduces the amount of material used in the process. 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
- Extremely reduced likelihood of clogging and particle jamming in 3D printers
- Less waste material leads to decreased manufacturing costs
- Material properties are variable along the geometry of the component
- Reduced reliance on specific ink materials

APPLICATIONS
- Efficient "slip casting" for ceramic materials
- High-density films for gas-tight electrode layers in solid oxide fuel cells
Coatings and armor

PATENT STATUS

Patent Pending

ADDITIONAL TECHNOLOGIES BY THESE INVENTORS

- Frequency-Based Filtering of Mechanical Actuation
- Continuous Fluidic Printing Of MicroLEDs

University of California, Santa Barbara
Office of Technology & Industry Alliances
342 Lagoon Road, Santa Barbara, CA 93106-2055
www.tia.ucsb.edu
Tel 805-893-2073 | Fax 805.893.5236 | dobis@tia.ucsb.edu

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