Skysong Innovations
Advancing the Arizona State University Knowledge Enterprise

1475 N. Scottsdale Road, Suite 200
Scottsdale, AZ 85287-3538
Phone: 480 884 1996 Fax: 480 884 1984

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3D-Printed Nanocomposites Enhanced with Metal Diboride Nanosheets

Inventors

Alexander Green
Matthew Gilliam
Ahmed Yousaf
Qing Hua Wang

Contact

Shen Yan
shen.yan@skysonginnovations.com

Background

Of the many types of 3D printing, stereolithography (SLA) tends to produce the best resolution. SLA involves selectively curing a liquid photocurable polymer precursor with 2D light patterns to create a layered 3D structure. Because the precursors to SLA are liquid, mixing in nanoscale fillers allows effective 3D printing of nanocomposites that are enhanced by the material properties of the filler.

Metal diborides (MB2) are a family of compounds known for their exceptional material properties, which may include high-temperature superconductivity, ultra-high melting points (>3000°C), and high hardness. Liquid dispersions of MB2 nanosheets can be achieved by liquid-phase processing, presenting promising possibilities as fillers for 3D-printed nanocomposites.

Invention Description

Researchers at Arizona State University have developed a process that efficiently integrates MB2 nanosheets into 3D-printed nanocomposites using a range of polymer matrices. Using this technique, dispersions of CrB2, MgB2, and TiB2 nanosheets were formed, subsequently mixed into Polar Resin 48 (a commercial prototyping polymer) or poly(ethylene glycol) diacrylate (PEGDA), and then printed by SLA into 3D nanocomposites. Preceramic nanocomposites have also been successfully fabricated using this process. With MgB2 nanosheets and preceramic polymers, nanocomposite structures were printed and pyrolyzed to produce final ceramic products.

Potential Applications

- High-resolution additive manufacturing
- Stereolithography
- Fabrication of nanocomposites for extreme conditions including in the aerospace and medical fields

Benefits and Advantages

- Process utilizes low-cost liquid-phase exfoliation

- Incorporation of MB2 in nanocomposites opens possibilities for increased thermal resistance, mechanical hardness, chemical resistance, durability, and catalytic activity

- Scalable process allows MB2 nanocomposites to broaden range of industrial uses of 3D-printed structures

Laboratory Homepage of Professor Alexander Green

Laboratory Homepage of Professor Qing Hua Wang