Machinery

Three-dimensional printing of continuous-fiber composites

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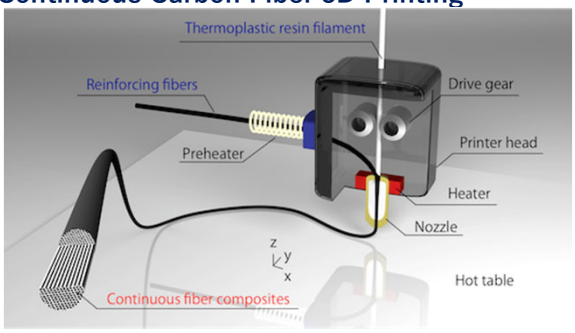
Purpose of Research

Conventional polymer-based 3D printers on the market can readily fabricate intricate three-dimensional shapes without the need for molds or jigs; however, the resulting parts lack sufficient mechanical strength for high-quality industrial applications. This research project is developing a 3D-printing technology that employs continuous carbon-fiber-reinforced polymer composites, enabling the production of high-strength, high-stiffness components for automotive and aerospace structures as well as medical and welfare devices that reliably support everyday life.

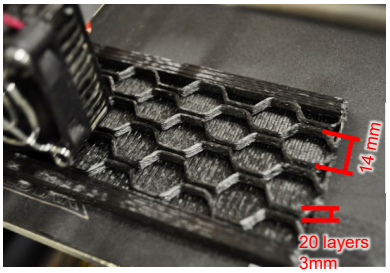
Summary of Research

This technology not only enables continuous carbon fiber composites to be printed in a single uninterrupted path, but also actively calculates and proposes the optimal fiber orientations and fiber volume fractions tailored to specific performance requirements. By doing so, it opens new possibilities for structural design and product innovation.

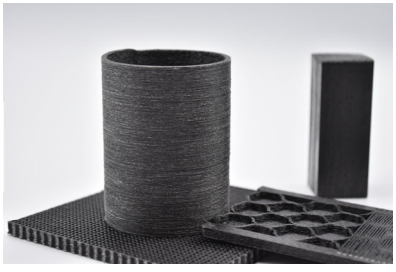
High-Strength Three-Dimensional Fabrication Using Continuous Carbon Fiber 3D Printing



Fabrication Process



Printed Samples



POINT

- Controlled fiber orientation and volume fraction
- In-situ impregnation of reinforcing fibers into thermoplastic resin
- Significant reduction in manufacturing costs

Comparison with Conventional or Competitive Technologies

By utilizing continuous carbon fibers, this technology achieves a dramatic improvement in both tensile strength and stiffness compared to commercially available industrial 3D printing methods such as powder bed fusion, stereolithography, and fused deposition modeling.

Expected Applications

- Structural components for automotive and aerospace applications
- Medical and rehabilitation devices for welfare support
- Sports equipment and recreational gear

Challenges in Implementation

- Key technologies such as continuous carbon fiber 3D printing and fiber orientation optimization have already been developed.
- The current challenge lies in elevating the quality of the printed components to match that of conventional CFRP products.

What We Expect from Companies

- This technology is particularly suitable for companies that require small-lot, high-mix production of structural components with high strength.
- We seek collaborative research with companies that possess the capability to commercialize this technology into a complete manufacturing system, as well as those looking to enter the 3D printing field as a new business opportunity.

Future Developments

2025 Development of Evaluation Methods for Printed Components
2026 Advancement of Forming Quality

■Associated System:
Strategic Core Technology Advancement Program (Supporting Industry Program)
NEDO Project, Next Generation Structural Material Creation - Development of Processing Technology
■Collaborating Institutions:
Tokyo University of Science, Nihon University, JAXA, and others
■Laboratory Website: https://www.rs.tus.ac.jp/rmatsuza/

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