Materials & Chemicals

New, Lightweight Material to Protect Against Bullets and Other High-Speed Impacts

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The Wisconsin Alumni Research Foundation is seeking commercial partners interested in developing a strong, lightweight material made of carbon nanotubes that shows superior ability to protect against high-impact ballistics including bullets and air and space debris.

Overview

Manufacturers require material that can absorb a high amount of kinetic energy from ballistic impacts to produce protective equipment such as bulletproof vests and tank armor, and air- and spacecraft that can withstand continuous micro-debris impacts. The stronger and lighter the material, the more agility and fuel efficiency it provides.

Materials made of nanofibers have the potential to provide unprecedented performance – surpassing that of lightweight, high-performance synthetic materials such as Kevlar® (DuPont) and ultra-high-modulus polyethylene. Carbon nanotubes possess superior stiffness, strength and energy dissipation. However, the weak nature of van der Waals interactions, which gives the molecule its structure, limits them from achieving greater performance.

The Invention

A UW-Madison team has developed an efficient way to enhance the inter-fiber interactions in carbon nanotubes. By mixing the nanotubes with Kevlar nanofibers, they have created a material with unprecedented strength. Under supersonic impacts, the strengthened carbon nanotube material had enhanced energy absorption up to 100 percent, far surpassing currently used materials and nanomaterials. The new material also has an ultra-high strain rate, meaning it has high resistance to extreme environments.

Applications

- Extreme engineering applications such as defense, civilian protection and aerospace

Key Benefits

- Provides a novel design pathway for ultra-strong, ultra-durable lightweight materials by enhancing the performance of carbon nanotubes
- Material outperforms currently widely used materials and nanomaterials in energy absorption at a much lighter weight.
- The intrinsic structure of nanomaterials provides exceptional resistance to stress and extreme environments.

Stage of Development

[illegible]
performance. Impact tests were performed on each of three samples using a state of the art laser-induced microprojectile impact testing

system at speeds ranging from 100 meters/second to 1 kilometer/second. About 10 tests were conducted for each sample at each speed. The results showed a nearly 100 percent increase in energy absorption.

Additional Information

For More Information About the Inventors

- Ramathasan Thevamaran

Publications

- Cai J, Griesbach C, Thevamaran R. Extreme Dynamic Performance of Nanofiber Mats under Supersonic Impacts Mediated by Interfacial Hydrogen Bonds. ACS Nano. 2021;15,12,19945-19955. doi: 10.1021/acsnano.1c07465.

Tech Fields

- Materials & Chemicals : Composites
- Materials & Chemicals : Synthesis

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