

Nanotechnology to Produce Better Protective Armor

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In materials science, enhancing one characteristic of a material will see a decline in a different characteristic. Strength and toughness are a pair like that: Usually, when you get high strength, you lose something in the toughness. The material becomes more brittle and therefore doesn't have the mechanism for absorbing energy, and it tends to break.

Researchers at MIT have developed a process that can produce ultrafine fibers — whose diameter is measured in nanometers, or billionths of a meter — that are exceptionally strong and tough. These fibers, which should be inexpensive and easy to produce, could be choice materials for many applications, such as protective armor and nanocomposites. The development might lead to protective materials that are as strong as existing ones but less bulky, making them more practical.

The process called gel electrospinning uses a variation of a traditional method called gel spinning but adds electrical forces. The results are ultrafine fibers of polyethylene that match or exceed the properties of some of the strongest fiber materials, such as Kevlar and Dyneema, which are used for applications including bullet-stopping body armor, ropes for extreme uses, and as reinforcing fibers in some high-performance composites.

Compared to carbon fibers and ceramic fibers, which are widely used in composite materials, the new gel-electrospun polyethylene fibers have similar degrees of strength but are much tougher and have lower density. That means that, pound for pound, they outperform the standard materials by a wide margin.

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