NANO DESIGN WORKS

Argonne NATIONAL LABORATORY

TINY PARTICLES WITH BIG MAGNETIC POWER

Magnetic nanofibers have wide-ranging applications

An Argonne researcher works with a new magnetic nanofiber that is used to create more efficient magnets. The new technology could lead to improvements in diverse applications, including those in medicine, water treatment, and harvesting of radio frequency energy, which could allow a battery to recharge itself by using energy from signals traveling through the air.

CHALLENGE

Magnets are nearly ubiquitous in our lives, with wide-ranging applications from electronics to motors to electrical power generation. As the need for more powerful and efficient magnets increases, new materials are required to meet that demand. Some progress has been made toward using rare earth metals in improved magnets for electric motors and generators, but Argonne scientists wanted a better solution.

Looking to tiny particles for big results, an Argonne team led by Xing Chen developed a new material known as magnetic nanofibers that meet the magnetic need, but can also be used for such wide-ranging purposes as medicine, water filtration, and harvesting of radiofrequency energy that could one day allow a battery to recharge itself using energy from signals traveling through the air. The new materials have fascinating possibilities for microwave applications that could create new types of antennas that increase the power and quality of a cell phone's signal while reducing its energy consumption. Not content to stop at that discovery, the Argonne team went further by building an Integrated Electrospinning System that can create the fibers in useful quantities.

SOLUTION

Magnetic nanofibers are special not only for their inherent properties as individual tiny magnets, which allow the creation of better magnets, but for their ability to be manipulated and deposited precisely to form materials with novel properties. By changing the shape and alignment of the fibers—including the development of magnetic nanotubes —Argonne scientists have created extremely powerful magnets without rare earth materials, new types of sensors, and an exciting new membrane technology that could transform wastewater treatment and make desalination much less energy intensive.

BENEFITS AND APPLICATIONS

Magnetic nanofibers will provide societal benefits quickly via their ability to create powerful magnets to drive more efficient electric motors, enhance energy generation, and improve electronics. The long-term benefits are much more widespread, with broad applications across dozens of scientific areas, including tunable microwave materials, passive components for power electronics, and catalytic membranes.

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