

Scientists create cheaper magnetic material for cars, wind turbines

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Scientist Arjun Pathak arc melts material in preparation for producing a new type of magnet.

Karl A. Gschneidner and fellow scientists at the U.S. Department of Energy's Ames Laboratory have created a new magnetic alloy that is an alternative to traditional rare-earth permanent magnets.

The new alloy—a potential replacement for high-performance permanent magnets found in automobile engines and wind turbines—eliminates the use of one of the scarcest and costliest [rare earth elements](#), [dysprosium](#), and instead uses cerium, the most abundant rare earth.

The result, an alloy of neodymium, iron and boron co-doped with cerium and cobalt, is a less expensive material with properties that are competitive with traditional sintered magnets containing dysprosium.

Experiments performed at Ames Laboratory by post-doctoral researcher Arjun Pathak, and Mahmud Khan (now at Miami University) demonstrated that the cerium-containing alloy's intrinsic coercivity—the ability of a magnetic material to resist demagnetization—far exceeds that of dysprosium-containing magnets at high temperatures. The materials are at least 20 to 40 percent cheaper than the dysprosium-containing magnets.

"This is quite exciting result; we found that this material works better than anything out there at temperatures above 150° C," said Gschneidner. "It's an important consideration for high-temperature applications."

Previous attempts to use cerium in rare-earth magnets failed because it

reduces the Curie temperature—the temperature above which an alloy loses its [permanent magnet](#) properties. But the research team discovered that co-doping with cobalt allowed them to substitute [cerium](#) for dysprosium without losing desired magnetic properties.

Finding a comparable substitute material is key to reducing manufacturing reliance on dysprosium; the current demand for it far outpaces mining and recycling sources for it.

The paper, "Cerium: An Unlikely Replacement of Dysprosium in High Performance Nd-Fe-B Permanent Magnets" was published in *Advanced Materials*.

More information: "Cerium: An Unlikely Replacement of Dysprosium in High Performance Nd–Fe–B Permanent Magnets." *Adv. Mater.*, 27: 2663–2667. [DOI: 10.1002/adma.201404892](https://doi.org/10.1002/adma.201404892)

Provided by Ames Laboratory

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