Team to develop supermagnets using materials that mimic iron-nickel found in meteorites

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(Phys.org)—Joseph Goldstein, an engineering professor at the University of Massachusetts Amherst, is part of a research team trying to produce an iron-nickel alloy that is currently only found in meteorites, for use in making supermagnets. The goal of the research is to develop bulk quantities of commercially viable, environmentally sound supermagnets, which can be used in electric vehicles, wind-turbine generators and many other machines.

The first phase of the work is funded by an 18-month, $3.3-million grant from the U.S. Department of Energy's (DOE) Advanced Research Projects Agency–Energy program. The UMass Amherst share of the grant is approximately $300,000.

Researchers are looking for a way to realign the crystalline structure of inexpensive iron and nickel, metals found abundantly on Earth into a new structure, FeNi known as tetrataenite, which has the super-magnetic properties they seek. Right now, tetrataenite is only found in meteorites.

The effort to recreate the iron-nickel mineral from outer space is driven by basic Earth-bound economic factors. Goldstein says, "The strongest magnets available in the world are made with rare earth elements. Several of these in combination with iron make extremely strong magnets. The basic problem is that the Chinese own 95 percent of the mines that produce rare earth minerals and therefore control their

availability and cost. So we need to create these strong magnets in another way."

That's where the focus on meteorites and the tetrataenite comes in. Goldstein, a world-renowned expert on meteorites, has been studying tetrataenite for decades. "At UMass, our particular task is to look at the meteorites," Goldstein says. "We're trying to learn composition ranges, get some ideas about how the mineral formed, and do some structure measurements on them at the nano-scale."

He says a basic task is to reorder the atoms using the plentiful iron-nickel we have on Earth, realigning the layers of iron and nickel in a very specific way to make it highly magnetic. It's proving to be a difficult task, says Goldstein.

If the team succeeds, however, the payoff could be significant because the world market for permanent supermagnets is projected to exceed $20 billion by 2020.

It's also a challenge Goldstein welcomes. "For years I've been working on meteorites, which have a wealth of scientific interest but were thought to have no commercial value at all," says Goldstein. "And now we're finding something of commercial interest. The meteorites are informing us how to go about this industrial process."

Provided by University of Massachusetts Amherst