Researchers discover new uses for high tech alloy

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(Phys.org) -- Materials scientists at the U.S. Department of Energy's Ames Laboratory, Etrema Products, Inc. (EPI), and the Naval Surface Warfare Center Carderock Division have developed new ways to form a high tech metal alloy which promise new advances in sensing and energy harvesting technologies.

To look at it, a length of wire fabricated in the Ames Laboratory looks much like the kind of steel wire a do-it-yourselfer could pick up at the local hardware store. A sheet form of the material, fabricated by EPI, looks equally unassuming. But these materials are made of a high tech alloy called Galfenol, and the new forms of this “smart material” may be the key to future manufacturing breakthroughs like the creation of vibration free, quieter motors.

Galfenol, composed primarily of gallium and iron, was co-discovered in 1999 by the Ames Laboratory and the Naval Surface Warfare Center Carderock Division. Galfenol’s unique properties make it change shape when subjected to a magnetic field, and flexible enough for a variety of manufacturing processes.

The three organizations spent a decade designing the alloy, optimizing its properties and developing production processes. Now, they have perfected methods of producing the material in rolled sheet and in wire form, making it possible to use Galfenol-based smart parts in a variety of new applications, especially vehicle technologies, both commercial and military.

"Galfenol exhibits a unique set of material properties that allow us to process it using conventional rolling and wire drawing equipment while at the same time we can develop the anisotropic magnetic properties that we desire," said Eric Summers, Vice President and Chief Scientist of EPI. "In addition, we can machine Galfenol using standard mills and lathes and weld it to a variety of other materials. I know of no other current smart material that shows this flexibility in processing."

Tom Lograsso, Director of the Division of Materials and Engineering Science at Ames Laboratory, said the project was built on the collaborative success of the giant magnetostrictive material, Terfenol-D. The goal was to find an alloy with similar properties to Terfenol-D, which changes shape when subjected to a magnetic field, but not as brittle.

"Terfenol is like glass. If you drop it on the floor, it shatters. It also can be very prone to corrosion. Galfenol bounces if you drop it; it can be machined; it can be welded. That has generated some new ideas about how to use this material," said Lograsso.

Galfenol can be used as a vibration-based energy-harvester; attached to a vehicle motor it could supply power to the large number of sensors present on a vehicle. The material could also be used to supply power to wireless sensor networks via the same energy harvesting capability. The combination of magnetic and mechanical properties could lead to the development of active motor mount technology—creating an environment that actively senses and cancels out motor vibrations, effectively creating a "silent" motor.

"Galfenol is receiving strong interest in the energy harvesting community worldwide. Several companies are developing prototype devices based on Galfenol technology as the power conversion component; the core technology in a vibration-based energy harvester," said Eric Summers of

EPI.

Provided by Ames Laboratory