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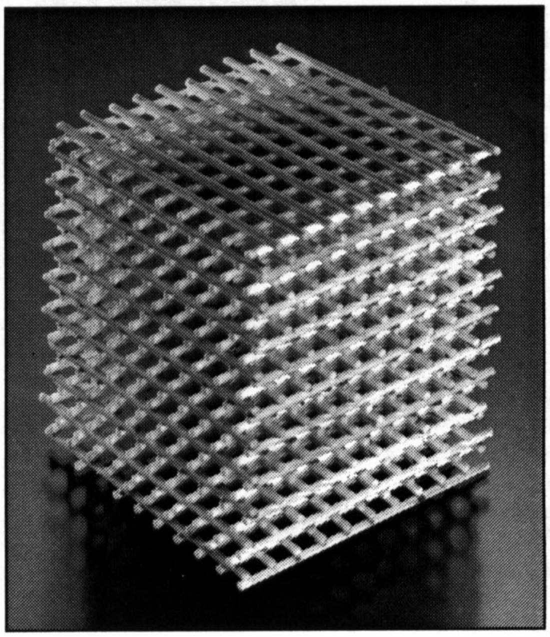
Ames Lab Scientists Win Energy 100 Awards

One of the last official duties of Secretary Bill Richardson before departing the Department of Energy was to recognize the winners of DOE Energy 100 Awards.

These awards honor the best 100 scientific and technological accomplishments since the DOE's creation in 1977. They celebrate the many innovations sponsored by the DOE that improve quality of life and save money for consumers. "Too often our discoveries and innovations go unnoticed. These awards symbolize the commitment of our scientists and engineers and the difference they make for the American people," said Richardson.

Not surprisingly, Ames Laboratory research was recognized on the Energy 100 Awards list. Number 24 on the top-100 list was photonic bandgap structures, which was one of only three discoveries and innovations recognized in 1990. Lead-free solder was 36th on the list; one of only two research projects recognized in 1994. Magnetic refrigeration made the 59th spot on the list and was one of 10 discoveries and innovations recognized in 1997.



Photonic bandgap structure

Lead-free solder

More than a decade ago, a few visionary scientists began contemplating all the applications that might ensue if a material could be constructed that would manipulate light the way semiconducting materials can be designed to manipulate electrons. In 1990, Ames Laboratory senior physicists Kai-Ming Ho and Costas Soukoulis and physicist Che-Ting Chan made the dream a reality by demonstrating a fabricated dielectric structure possessing a photonic band gap. Since 1990, the feature sizes of PBG crystals have been made smaller and smaller so that the devices can be used to manipulate radiation from microwaves to visible light. Applications range from superior direction antennas to more efficient lasers and soon to optical chips where there are advantages of using photons instead of electrons.

Environmental and market forces are *continued on page 2*

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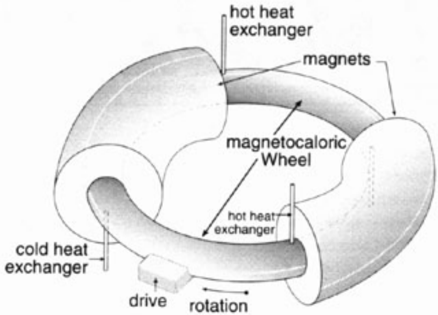
pushing the U.S. electronics industry to use environmentally friendly products. Reacting to that push, the international electronics industry plans to select only two "universal" lead-free solder alloys for different electronics assembly tasks, if possible within about one year. The leading candidate for a universal paste-type solder is an alloy composed of tin, silver and copper, which was developed by a team of scientists lead by Iver Anderson, Metallurgy and Ceramics program director. Besides eliminating a known health hazard, lead, Anderson's solder has a low melting point, stands up well to corrosion and oxidation, and remains strong at high temperatures. If selected as the new universal lead-free solder paste alloy, the era of leaded solder cannot end too soon. The EPA estimates that discarded electronics add 50,000 tons of lead to the solid waste stream each year.

Magnetic refrigeration as a potentially reliable cooling technology gained national attention in 1997 when senior metallurgists Karl Gschneidner Jr. and Vitalij Pecharsky discovered a material that could replace volatile liquid chemicals as coolants in refrigerators. Magnetic refrigeration takes advantage of the magnetocaloric effect, the ability of some materials to heat when magnetized and cool when removed from the magnetic field. Using this technology, Gschneidner and Pecharsky were able to collaborate with Astronautics Corporation of America to build a proof-of-principle apparatus that demonstrated magnetic refrigeration as a reliable, competitive cooling technology. Research has continued, and the scientists have now discovered the giant magnetocaloric effect in gadolinium-silicon-germanium alloys. The magnetocaloric effect in these alloys is two to 10 times larger than other prototype refrigerants. Currently, Gschneidner, Pecharsky and senior metallurgist David Jiles are working with Astronautics to build a prototype magnetic refrigerator, which will generate enough cooling power for commercial applications, such as supermarket chillers, building air-conditioning systems and frozen-food processing plants. Other applications include household refrigerator/freezers and air conditioners and climate-control units for automobiles, buses, trains and aircraft.



An artist's conception of a rotary magnetic refrigerator.

Reacting to the announcement of the Energy 100 Awards, Ames Lab Director Tom Barton said he was not surprised. "Since the Lab's beginning, our scientists have committed themselves to performing cutting-edge research that benefits the American taxpayer. These latest awards are yet another indication of that strong and continued commitment. I congratulate our scientists on their awards." ■

– Steve Karsjen