workshop aware of past studies indicating that conversion to a hydrogen-based economy would be next to impossible in the foreseeable future. "As physicists, we read these things and assume they are right, that the problem of using hydrogen [as an everyday energy source] is so hard that it can't be solved," she said. "But there are a lot of advances and new developments out there that haven't been applied to hydrogen problems, and many people in relevant fields haven't been thinking of hydrogen as a research focus," Dresselhaus continued. "I'm hoping this report will get the word out in the community."

To move toward a viable hydrogen-based economy, the report says that significant advances are needed in materials science, nanotechnology, catalysts and catalytic performance, biological and "bio-inspired" energy conversion designs, and instrumentation. Beyond those issues, the report says there must be a hydrogen infrastructure "that provides seamless transitions from production to storage to use." Such a system must be "equivalent to those now in place for the production and use of fossil fuels and for electricity."

Hydrogen must also be economically competitive with existing energy systems and, at the moment, the gaps are enormous, the report says. Currently, proton-exchange membrane fuel cells for automobiles deliver power at about $3000 per peak kilowatt compared with $35 for the same unit of energy from an internal combustion engine, the report says.

One of the defining problems that indicates how far research has to progress, said workshop associate chair George Crabtree of Argonne National Laboratory, "is a system that would store enough hydrogen in a vehicle for a 300-mile trip and be fast enough to allow for acceptable acceleration of the vehicle."

Such a vehicle isn't likely for many years, but Crabtree said scientific advances in computing, nanotechnology, and other fields are providing hydrogen research with tools "that weren't there 10 years ago." Whether a hydrogen economy is really feasible remains an open question, "but we want to make the basic research community aware of the opportunities in this field," he said.

Jim Dawson

Aerobics Acoustics Can Harm Hearing

Working out at a gym may improve your muscle tone, but both the staff and exercise participants could damage their ears from the loud music, says physicist Eugenie Mielczarek of George Mason University in Fairfax, Virginia. Over the past three years, Mielczarek measured sound levels in aerobics and other exercise classes at three fitness clubs in Fairfax County. At some clubs, sound levels reached 120 decibels, "close to that of using a jackhammer," she says.

Regular exposure to loud music slowly destroys the delicate hair cells inside the ear, which reduces the volume and frequency of information transmitted to the brain. Since 1991, the American Council on Exercise (ACE) has published noise level guidelines for its members, but few instructors follow them. The guidelines, based on recommendations by the Occupational Safety and Health Administration, limit noise levels over an eight-hour period to under 85 dB—the equivalent of noise from heavy traffic. But some national fitness club chains hold 45-minute-long classes at 110 dB, says Mielczarek, and most instructors teach six to eight classes each day. "The club staff were either unaware that [ACE] guidelines existed or asked me to leave the class when I asked them to turn the sound down," she adds.

But the volume may soon be turned down for a different reason, says Cedric Bryant, ACE's chief exercise physiologist. "We've been finding that a lot of instructors are suffering voice damage from shouting over the music," he says.

Paul Guinnessy

EUGENIE MIELCZAREK

Loud music at fitness clubs may destroy your hearing, says physicist Eugenie Mielczarek (above).

Army Grants $50 Million for Biotech Research

The Army Research Office (ARO) has awarded a $50 million contract to a three-university consortium to create the Institute for Collaborative Biotechnologies (ICB), a research organization that will focus on creating sensors, electronics, optics, and information-processing systems based on what the army describes as "biologically derived and biologically inspired materials." The new institute, to be headed by the University of California, Santa Barbara, is intended to "improve dramatically the effectiveness of the army by creating a single conduit for developing, assessing, and adapting new products and new biotechnologies in direct support of the army's mission," said Jim Chang, ARO's director.

In addition to UCSB, the institute will include MIT and Caltech, as well as several industrial partners who will help the university laboratories with new technology development. Daniel Morse, chair of UCSB's biomolecular science and engineering program, will direct the ICB.

"Biology uses precise mechanisms to produce exquisitely structured materials, and that coordination of biological function at the molecular, cellular, and systems level takes place by remarkably effective communication and information transfer," said Robert Campbell, the army's program officer for the grant. "The idea is to understand biological mechanisms and to harness them for design and fabrication of new materials, devices, and systems."

An example of what the ICB will be trying to develop is recent work by Morse. He has shown that fiberglass silica needles of a certain marine sponge are made via a protein, which acts as both an enzyme–catalyst and a template for growth. That discovery has been adapted to make photovoltaic and nonbiological semiconducting materials.

The new ICB research group will include "the world's leaders in discoveries of these underlying molecular mechanisms in nanobiofabrication," said Morse. "Our aim is to integrate work at the three campuses in a seamless way."

In addition to Morse, the ICB leadership will include Frank Doyle, a UCSB chemical engineer; MIT's Angela Belcher, a professor of materials and biological engineering; and David Tirrell, chair of chemistry and chemical engineering division at Caltech.

Jim Dawson