Sound Research Aids the Deaf

When Sasha was adopted at age six, her new parents were warned that she was profoundly deaf. Three years later, Sasha runs around the house like any nine-year-old, and she can hear her parents, thanks to a cochlear implant under the skin behind her ear. An external microphone and processor pick up sound, convert it to electric impulses, and transmit it to the implant, which activates 16 electrodes that stimulate the auditory nerve. The brain then processes the signals as sound. More than 100 000 people worldwide have been fitted with such implants since the 1980s. New advances promise to make implants safer to install and more sensitive to sound.

A traditional implant consists of a bunch of wires encased in silicon, "a bit like a thick strand of spaghetti," says Soli Sigfrid, an expert on hearing at the House Ear Institute in Los Angeles. The most exciting areas of cochlear research, he says, are in bilateral, hybrid, and smaller implants. Bilateral implants would go on both ears, so the wearer could process sound in stereo. Hybrid implants would restore hearing at high frequencies for people who can still hear low frequencies. And reducing the size makes devices easier to install.

A group of engineers at the University of Michigan is developing an implant that is about half the size of current models and has up to 128 electrodes on a ribbon-like thin film. As with today's implants, the electrodes feed into the snail-shaped cochlea of the inner ear, but in the Michigan design the electrodes go deeper, making lower frequencies accessible. "More [electrodes] mean greater tonal range and better frequency perception," says the Michigan group's Kensall Wise, "and the implant's flexibility will minimize damage to existing hearing." The new implant would help wearers cope with background noise, hear nuances in music, and understand tonal languages, such as Chinese. (Visit http://www.physicstoday.org for audio samples comparing sound perception for new and old cochlear implants and normal hearing.)

The ribbon-like implants do have a couple of weaknesses, Sigfrid says. "The thin-film electrode is like putting a surgical knife next to the nerve. . . . And the fluid in the inner ear is conductive. . . . Putting the electrodes too close together may cause interference." To avoid damaging the nerve, says Wise, position sensors are integrated onto the ribbon. "With the position sensors, doctors can see, on a screen, a silhouette of the ribbon against the shape of the cochlea." The idea is to eventually have the sensors control the insertion tool to automatically navigate around any obstacles, he says. Currently the implant is being tested on guinea pigs and cats. "The technique is promising," says William Yost, a professor in hearing sciences at Loyola University in Chicago, "but it's still some way off from being tested in humans."

Researchers at Advanced Bionics in Sylmar, California, are focusing on upgrading the software in the processors of cochlear implants to improve a wearer's sound perception by exploiting interference between electrodes. The advantage of that approach is being able to upgrade existing implants without surgery.

"Ultimately the goal is to make a device that is fully implantable under the skin," says Sigfrid. "That's still down the road a bit."

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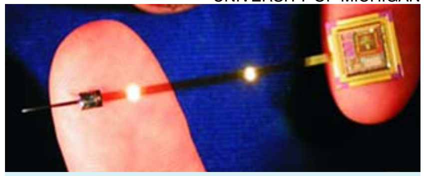

Thin-film-based cochlear implants may enhance hearing.

Bodman Offers Hydrogen Road Map

Three years after President Bush announced a $1.2 billion hydrogen fuel initiative in his 2003 State of the Union address, US Department of Energy Secretary Samuel Bodman has unveiled a "road map" intended to guide research and get hydrogen fuel cell vehicles into show rooms by 2020. Along with the 80-page "Roadmap to Advance Hydrogen Fuel Cell Vehicles," Bodman announced grants totaling $119 million aimed at "identifying and overcoming the technical and manufacturing challenges" that face the development of a practical transportation system based on hydrogen.

While the administration has been touting the prospect of hydrogen cars for the past few years, researchers have regularly cautioned that the scientific problems associated with such vehicles are considerable. A 2003 DOE hydrogen workshop report concluded that the transition from a fossil-fuel-based economy to one based on hydrogen would require "revolutionary, not evolutionary" scientific advances (see PHYSICS TODAY, October 2003, page 35).

Although Bodman made the announcement at an auto show in Washington, DC, on 24 January, much of the focus of the program is on basic research and "critical path technology barriers" to develop efficient, inexpensive hydrogen fuel cells. DOE has set aside $100 million and is soliciting proposals for research on such things as improved fuel cell membranes, cathode catalysts, and fuel cell concepts. Another $19 million will go to 12 already-selected projects, at both universities and private research companies, for R&D on polymer electrolyte fuel cell membranes.

The road map recommends research in hydrogen production, delivery, and storage. It also notes that advanced hydrogen technologies need to be developed "to the point that industry can make commercialization decisions on hydrogen fuel cell vehicles and fuel infrastructure by 2015 so these technologies can begin to penetrate consumer markets by 2020."

MIT physicist Mildred Dresselhaus, who chaired the 2003 DOE hydrogen workshop, said the transition from a fossil-fuel-based economy to a hydrogen economy is not a sure thing and such a change should be thought about on a 40-year timeline (see PHYSICS TODAY, December 2004, page 39). "You have to get the technologies in place and get the industries behind it. We really don't know what the right path is yet." Dresselhaus praised Bodman for "coming out and explaining that basic research is needed to get us from here to there, and also for making clear that the basic research will have a positive impact on any of the solutions to the [energy] transition problem, even if the solution is not hydrogen."

Jim Dawson

News Notes

More jobs, less security. Academic jobs in physics and astronomy in the US are proliferating but, reflecting a wider trend in academia, the bulk of the growth is in non-tenure-track positions. So says a recent report by the American Institute of Physics.

From 1994 to 2004, the number of faculty positions in physics and astronomy grew by about 1% a year, from 8200 to 9000 total, with the largest chunk in PhD-granting departments. In 2000, 11% of faculty positions in PhD departments were non-tenure track or temporary; in 2004, that percentage was 18%.

The numbers of African American