Hearing aids given nanotech spin

By R. Colin Johnson

Portland, Ore. — Nanotech hearing aids due out next month will carry spintronic sensors that automatically adjust to accommodate the source of sounds. If a phone is held to the wearer's ear, for example, the hearing aid will automatically switch modes without the person's intervention.

Giant magnetoresistance (GMR) sensors from NVE Corp. (Eden Prairie, Minn.) are at the heart of the hearing aids, built by Starkey Laboratories (Minneapolis).

The sensors are based on a chip that uses electron spin rather than charge to store information. By automatically switching modes, the sensor frees a wearer from today's need to switch either manually or with a bulky switch. The sensor, one-third the size of the switch's coil, is built from nanoscale layers of magnetic thin films just a few atomic layers thick.

The result, say both companies, is a magnetic sensor that's smaller, more precise and less power-hungry than devices available today. "Our hearing aids can now be built much smaller and perform significantly better," said Dale Lizakowski, a quality engineer at Starkey Labs. "I have personally worn and tested the GMR sensor, and it performs well above and beyond any other technology for switching sensitivity, overall reliability and ultrasmall size."

Mode switching in today's hearing aids either is performed by the wearer or requires a bulky reed-switch that's based on a coil almost three times bigger than the NVE sensor.

For NVE, this latest application expands its technology's thrust. "Most people think of hard-disk recording when they think of giant magnetoresistance," said Daniel Baker, NVE's president and chief executive officer. "But we have found many other industrial uses for GMR-based sensors. We also think that GMR spintronics will be a real enabler for medical electronics."

The medical sensor market will grow to $845 million in 2008, up from $600 million in 2003, The Freedonia Group predicts.

NVE'S first medical electronics customer was St. Jude Medical Inc. in Minneapolis. Doctors there use NVE's technology to poll pacemakers and defibrillators implanted in patients. With nano-scale spintronics, the NVE sensor allows noninvasive high-speed communication between a doctor's computer and the implanted device. Not only can a patient's medical history file be kept current with data downloads from the device, but new functionality can be uploaded to the implant without having to remove it.

A common housefly dwarfs the 1.2 x 1.3-mm GMR sensor to be used in Starkey Labs' hearing aids.

But it took NVE almost five years to obtain U.S. Food and Drug Administration approval for the device, prompting the company to target medical devices not critical to life support, such as hearing aids, which will likely win FDA approval far more quickly. "We are very proud of our success with the St. Jude Medical implants, but because we are still a small [70-employee] company, we now want to target medical applications with shorter approval cycles," Baker said.

NVE was founded in 1989 with technology licensed from Honeywell International. More than $40 million in government research contracts have kept NVE working at nanoscale spintronics. For the military, for instance, NVE has designed MRAMs as well as sensors for land-mine detection and other security applications.

The hearing aid's GMR sensor element, when combined with conventional electronics on a single chip, measures just 1.2 by 1.3 mm—orders of magnitude smaller than the coil-based macroscale reed-switch sensors in use today.

In October 2004, NVE began delivering more than $100,000 worth of GMR-based chips to Starkey. While the chips could eventually be used in all of Starkey's hearing aids, initially they will be rolled out next month as an option for specific models.