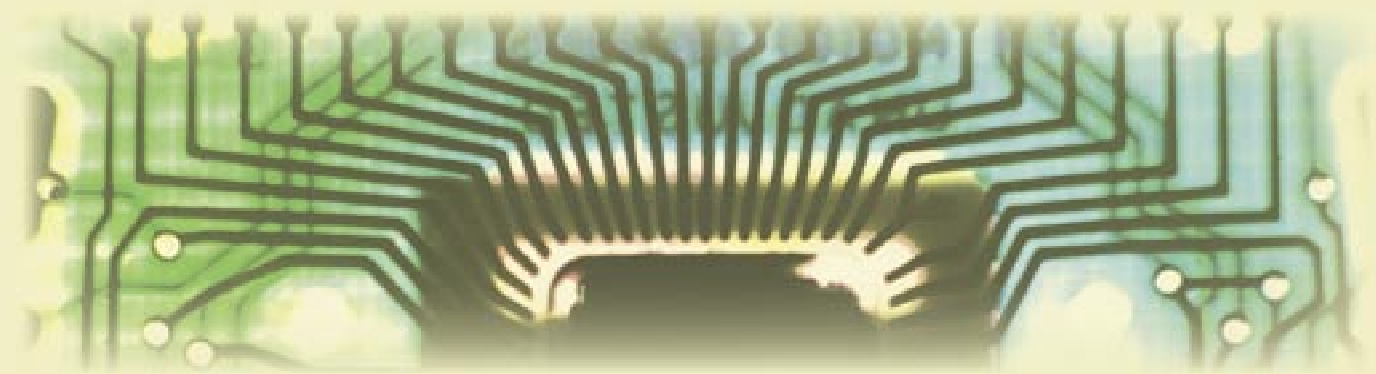

Computer Chip May Aid Bioterror Fight

Researchers have built a world-record high-frequency chip using a common type of semiconductor, an advance that could lead to inexpensive systems for detecting hidden weapons, and chemical and biological agents.

Engineers at the University of Florida and United Micro Electronics Corp., a Taiwan-based semiconductor manufacturer, announced in June that they had built the 105-gigahertz circuit using widespread complementary metal oxide semiconductor, or CMOS, technology — the same technology found in most of the chips in ubiquitous personal computers and handheld electronic devices.

The previous record for CMOS circuits was 103 gigahertz, reported in February of last year, but that circuit consumed four times more power than the newly announced circuit and was built using a more advanced technology. Gigahertz is a measurement of frequency, with one gigahertz equaling 1 billion cycles per second, or a wave repeating its motion 1 billion times in one second.

"It's a demonstration of what these standard technologies are really capable of, and it also opens up new application areas for CMOS," said Ken O, a UF professor of electrical and computer engineering.

In a related development, Swami Sankaran, a UF doctoral student in electrical engineering, and O have engineered a Schottky diode — a device that allows current to flow in a single direction — to operate at even higher frequencies of up to 1.5 terahertz, or 1.5 trillion cycles per second, using the same CMOS technology. That's the highest operating frequency for any devices built with the mainstream silicon technology.

Engineers have created such ultra-high frequency circuits in the past, but they have been too expensive for commercial use because of the exotic nature of the materials involved.

Steve Maas, chief scientist at Applied Wave Research, a California-based supplier of high-frequency electronics, said the cost is gradually coming down but that high-frequency chips built using the standard CMOS are a recent and surprising alternative.

"Until recently, no one would have imagined that CMOS could be capable of operating at such high frequencies," Maas said.

"The next logical step is to achieve this kind of high-frequency operation with a process that is designed for low-cost fabrication, and this seems to be what Ken has accomplished," Maas added. "I don't know what his limitations are, but it appears to be a very respectable accomplishment."

The UF advances suggest it would be relatively easy to transform the now experimental devices into inexpensively manufactured commodities — chips that in the near future might reach even higher frequencies.

"Using the diodes we have, it should be possible to build circuits operating at around 400-gigahertz," O said. "Within the next one to two years, the advances in CMOS could enable fabrication of diodes good enough to build terahertz circuits with."

One of the exciting potential applications for such high-frequency devices is chemical and biological weapons detection, O said. The circuits' high operating frequency closely matches the vibrating frequency of the tiny pathogens and chemical bonds that make such weapons effective, O said.

"Many elements have spectral lines at these frequencies, so conceivably such circuits could be used to sense them," Maas said. "These are not technological pie in the sky. They are thoroughly practical, technologically, but cost has always been the main hang-up."

According to Maas, other applications for high-frequency sensors include "automotive radar for crash avoidance, adaptive cruise control, parking assistance (and) detection of obstacles."

The 105-gigahertz circuit was announced in a paper presented by O and Changhua Cao, a UF doctoral student in electrical and computer engineering, at the 2005 Symposium on VLSI circuits in Kyoto, Japan. A paper about the Schottky diode appeared in the July issue of the journal *IEEE Electron Device Letters*.

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