Advance made toward communication, computing at 'terahertz' speeds

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Physicists in the United States and Germany have discovered a way to use a gallium arsenide nanodevice as a signal processor at "terahertz" speeds, the first time it's been used for this purpose and an important step forward in the new world of optical communication and computing.

Existing communications and computer architecture are increasingly being limited by the pedestrian speed of electrons moving through wires, and the future of high-speed communication and computing is in optics, experts say. The Holy Grail of results would be "wireless interconnecting," which operates at speeds 100 to 1,000 times faster than current technology.

The new discovery, made by researchers at Oregon State University, the University of Iowa and Philipps University in Germany, has identified a way in which nanoscale devices based on gallium arsenide can respond to strong terahertz pulses for an extremely short period, controlling the electrical signal in a semiconductor. The research builds on previous findings for which OSU holds an issued patent.

"Optical communication uses the extraordinary speed of light as the signal, but right now it's still controlled and limited by electrical signaling at the end," said Yun-shik Lee, an associate professor in the OSU Department of Physics. "Electrons and wires are too slow, they're a bottleneck. The future is in optical switching, in which wires are replaced by emitters and detectors that can function at terahertz speeds."

The gallium arsenide devices used in this research can do that, the scientists discovered.

"This could be very important," Lee said. "We were able to manipulate and observe the quantum system, basically create a strong response and the first building block of optical signal processing."

The first applications of this type of technology, Lee said, would probably be in optical communications of almost any type - video, audio or others. The ultimate application could be quantum computing, in which computers would be orders of magnitude faster than they are now, working with a different physical and logic basis, not even using conventional transistors. Among other uses, their extraordinary speeds would make them extremely valuable for secure codes and communications.

The current use of gallium arsenide was done at the very low temperatures of liquid helium, which would not be practical for broader use. Other materials will need to be identified that can accomplish similar tasks at room temperature, the researchers said.

More information: The professional publication this story is based on is available online: ir.library.oregonstate.edu/jspui/handle/1957/16735

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