Lastest graphene research could lead to improvements in bluetooth headsets and other devices

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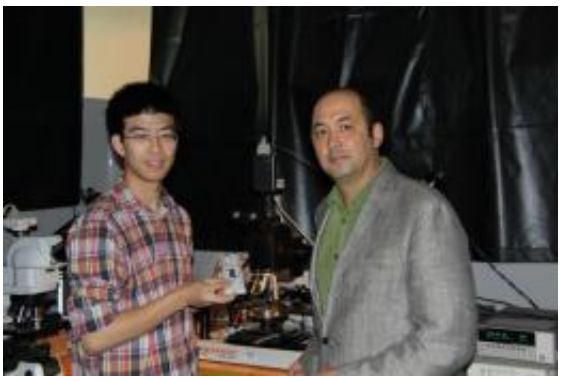

Alexander Balandin, right, and Guanxiong Liu, one of Balandin's graduate students

Researchers at the UC Riverside Bourns College of Engineering have built and successfully tested an amplifier made from graphene that could lead to more efficient circuits in electronic chips, such as those used in Bluetooth headsets and toll collection devices in cars.

Graphene, a single-atom thick carbon crystal, was first isolated in 2004 by Andre Geim and Konstantin Novoselov, who won the Nobel Prize in physics this month for that work. Graphene has many extraordinary properties, including superior electrical and heat conductivity, mechanical strength and unique optical absorption.

The demonstration at UCR of the graphene amplifier with signal processing functions is a major step forward in graphene technology because it is a transition from individual graphene devices to graphene circuits and chips, said Alexander Balandin, a professor of electrical engineering, who performed the work along with a graduate student and researchers at Rice University.

The triple-mode amplifier based on graphene has advantages over amplifiers built from conventional semiconductors, such as silicon, said Balandin, who is also chair of the UC Riverside Materials Science and Engineering program. The graphene amplifier reveals greater functionality and a faster speed because of graphene's electrical ambipolarity (current conduction by negative and positive charges).

It can be switched between different modes of operation by a simple change of applied voltage. These characteristics are expected to result in simpler and smaller chips, a faster system response and less power consumption.

The experimental demonstration of the graphene amplifier functionality was reported last week in the journal *ACS Nano*.

The fabrication and experimental testing were performed in Balandin's Nano-Device Laboratory. The co-authors of the paper are Guanxiong Liu, one of Balandin's graduate students, Kartik Mohanram, an assistant professor at Rice University, and Xuebei Yan, one of Mohanram's graduate students.

The researchers from Rice University designed the amplifier and testing protocol. Liu built the device in the UCR clean room. Liu and Yan then tested the amplifier in Balandin's lab.

The triple-mode amplifier can be charged at anytime during operation in

the three modes: positive, negative or both. By combining these three modes, the researchers demonstrated the amplifier can achieve the modulation necessary for phase shift keying and frequency shift keying, which are widely used in wireless and audio applications.

These applications include: Bluetooth headsets for cell phones; radio frequency identification (RFID), which is used in wireless products, including toll collection devices in cars, cards used to pay for public transportation and identification tags on animals; and ZigBee, a communication protocol used in devices such as such as wireless light switches with lamps and electrical meters with in-home-display.

More information: pubs.acs.org/doi/abs/10.1021/nn1021583

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