Graphene may gain an 'on-off switch,' adding semiconductor to long list of material's achievements

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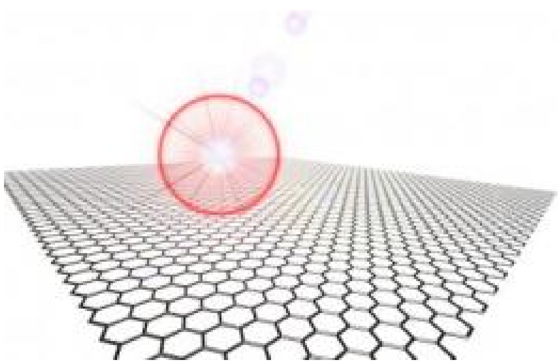

Graphene is illuminated by a laser field (artist image). Credit: Luis E. F. Foa Torres

A team of researchers has proposed a way to turn the material graphene into a semiconductor, enabling it to control the flow of electrons with a laser "on-off switch".

Graphene is thinnest and strongest material ever discovered. It's a layer of carbon atoms only one-atom thick, but 200 times stronger than steel. It also conducts electricity extremely well and heat better than any other known material. It is almost completely transparent, yet so dense that not even atoms of helium can penetrate it. In spite of the impressive list of promising prospects, however, graphene appears to lack a critical property -- it doesn't have a "band gap."

A band gap is the basic property of semiconductors, enabling materials to control the flow of electrons. This on-off property is the foundation of computers, encoding the 0s and 1s of computer languages.

Now, a team of researchers at the National University of Córdoba and CONICET in Argentina; the Institut Catala de Nanotecnologia in Barcelona, Spain; and RWTH Aachen University, Germany; suggest that illuminating graphene with a mid-infrared laser could be a key to switch off conduction, thereby improving the possibilities for novel optoelectronic devices.

In an article featured in *Applied Physics Letters*, the researchers report on the first atomistic simulations of electrical conduction through a micrometer-sized graphene sample illuminated by a laser field. Their simulations show that a laser in the mid-infrared can open an observable band gap in this otherwise gapless material.

"Imagine that by turning on the light, graphene conduction is turned off, or vice versa. This would allow the transduction of optical into electrical signals," says Luis Foa Torres, the researcher leading this collaboration. "The problem of graphene interacting with radiation is also of current interest for the understanding of more exotic states of matter such as the topological insulators."

More information: The article, "Tuning laser-induced band gaps in graphene," by H. Calvo, H. Pastawski, S. Roche, and L. Foa Torres appears in *Applied Physics Letters*. See: apl.aip.org/resource/1/applab/v98/i23/p232103_s1

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