Graphene lenses: 2-D electron shepherds

April 18 2012

Researchers discover that a deformed layer of graphene can focus electrons similar to the way an optical lens bends light.

Graphene, the one-atom-thick "wonder material" made of carbon, has another potential use in the world of high-speed electronics – as a tool that can focus a stream of electrons similar to the way an optical lens focuses light. A new prototype reveals that a layer of graphene, when strained through stretching, can act as a two-dimensional lens for electrons. The research, which is published in the American Institute of Physics' (AIP) journal *Applied Physics Letters*, was produced by an international group of researchers from the Karlsruhe Institute of Technology in Germany and the French National Center for Scientific Research (CRNS).

Graphene is an excellent conductor: electrons flow freely across its surface in straight lines. According to a previously proposed theory, highly strained graphene impedes the flow of electrons, slowing them down and altering their trajectory. Scientists believed this effect could be used to focus electrons to a fine point – similar to the way an optical lens creates areas of refraction, or bending, to shepherd light to a point.

To create the prototype lens, the team of French and German researchers built a "deformed graphene carpet" that smoothly covers a series of hexagonal nano-holes in a silicon-carbide wafer. Areas of the graphene were strained as they adopted the shape of the holes in the wafer. The researchers found that they could control the focal length of a graphene lens by changing its geometry. Practical applications of this work include

uses in high-speed electronics, where strained graphene could act as a transport medium for information exchange between different parts of a circuit. Unlike traditional information exchange, in which electrons flow through cables whose paths cannot cross without a short, the new method would allow electrons an unprecedented freedom of movement, similar to that of light in a vacuum.

More information: "A graphene electron lens" by Lukas Gerhard et al. is published in *Applied Physics Letters*. dx.doi.org/10.1063/1.3701594

Provided by American Institute of Physics