Graphene Transistors: Nanoscale Electronic Components

A transistor with semiconducting-type graphene layers bonded to the silicon terminal face

Walter Alexander de Heer from the School of Physics at Georgia Tech has designed a transistor with semiconducting-type graphene layers bonded to the silicon terminal face. The graphene layers allow for efficient heat dissipation and could enable significantly faster computer processing speeds.

The design allows graphene to function as a semiconductor and has significant potential for smaller, lighter, and higher speed circuitry.

Summary Bullets

- **Faster:** Near-ballistic charge transport properties
- **Cooler:** Virtually no heat generation at high speeds
- **Stronger:** 100 times stronger than steel

Solution Advantages

- **Faster:** Near-ballistic charge transport properties
- **Cooler:** Virtually no heat generation at high speeds
- **Stronger:** 100 times stronger than steel
- **Smaller:** Nanoscale for next-generation circuitry

Potential Commercial Applications

- High-speed microprocessors
- Nanoelectromechanical systems (NEMS)
- Microelectromechanical systems (MEMS)

Background and More Information

This technology is a graphene-based transistor that offers superior performance characteristics to silicon-based microelectronic circuitry. These circuits are found in all of the digital technology in use today. However, the current silicon-based computer processors can perform only a certain number of operations per second without

overheating. Nanoscale carbon-based circuitry offers potential as a replacement for silicon systems because carbon-based materials do not generate much heat, even when operating at extremely high speeds. Graphene—a form of carbon that is 1 atom thick—is strong and light, and it has excellent heat and electronic conductivity. But because graphene does not naturally switch on and off like semiconducting materials, it must be reengineered to perform as a semiconductor.

Inventors

- Dr. Walter de Heer
  Regents' Professor - Georgia Tech School of Physics

IP Status

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Publications

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