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[USA][Computer Science] Faster Computers, Electronic Devices Possible After Scientists Create Large-area Graphene On Copper

ScienceDaily (May 11, 2009) — The creation of large-area graphene using copper may enable the manufacture of new graphene-based devices that meet the scaling requirements of the semiconductor industry, leading to faster computers and electronics, according to a team of scientists and engineers at The University of Texas at Austin.

"Graphene could lead to faster computers that use less power, and to other sorts of devices for communications such as very high-frequency (radio-frequency-millimeter wave) devices," said Professor and physical chemist Rod Ruoff, one of the corresponding authors on the Science article. "Graphene might also find use as optically transparent and electrically conductive films for image display technology and for use in solar photovoltaic electrical power generation."

Graphene, an atom-thick layer of carbon atoms bonded to one another in a "chickenwire" arrangement of hexagons, holds great potential for nanoelectronics, including memory, logic, analog, opto-electronic devices and potentially many others. It also shows promise for electrical energy storage for supercapacitors and batteries, for use in composites, for thermal management, in chemical-biological sensing and as a new sensing material for ultra-sensitive pressure sensors.

Graphene can show very high electron- and hole-mobility; as a result, the switching speed of nanoelectronic devices based on graphene can in principle be extremely high. Also, graphene is "flat" when placed on a substrate (or base material) such as a silicon wafer and, thus, is compatible with the wafer-processing approaches of the semiconductor industry. The exceptional mechanical properties of graphene may also enable it to be used as a membrane material in nanoelectromechanical systems, as a sensitive pressure sensor and as a detector for chemical or biological molecules or cells.

The university researchers, including post-doctoral fellow Xuesong Li, and Luigi Colombo, a TI Fellow from Texas Instruments, Inc., grew graphene on copper foils whose area is limited only by the furnace used. They demonstrated for the first time that centimeter-square areas could be covered almost entirely with mono-layer graphene, with a small percentage (less than five percent) of the area being bi-layer or tri-layer flakes. The team then created dual-gated field effect transistors with the top gate electrically isolated from the graphene by a very thin layer of alumina, to determine the carrier mobility. The devices showed that the mobility, a key metric for electronic devices, is significantly higher than that of silicon, the principal semiconductor of most electronic devices, and comparable to natural graphite.

Journal reference:

Li et al. Large-Area Synthesis of High-Quality and Uniform Graphene Films on Copper Foils. Science, 2009; DOI: 10.1126/science.1171245
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