

Research paves way for new composite materials

July 19 2006

Northwestern University researchers have developed a process that promises to lead to the creation of a new class of composite materials -- "graphene-based materials."

The method uses graphite to produce individual graphene-based sheets with exceptional physical, chemical and barrier properties that could be mixed into materials such as polymers, glasses and ceramics.

The Northwestern team, led by materials scientist and physical chemist Rod Ruoff and composed of chemists, physicists and engineers, reports the results of their research in the July 20 issue of the journal *Nature*.

"This research provides a basis for developing a new class of composite materials for many applications, through tuning of their electrical and thermal conductivity, their mechanical stiffness, toughness and strength, and their permeability to flow various gases through them," said Ruoff, professor of mechanical engineering in the McCormick School of Engineering and Applied Science. "We believe that manipulating the chemical and physical properties of individual graphene-based sheets and effectively mixing them into other materials will lead to discoveries of new materials in the future."

The Northwestern team's approach to its challenge was based on chemically treating and thereby "exfoliating" graphite to individual layers. Graphite is a layered material of carbon with strong chemical bonds in the layers but with moderately weak bonds between the layers.

The properties of the individual layers have been expected to be exceptional because the "in-plane" properties of graphite itself are exceptional, but until now it was not possible to extract such individual layers and to embed them as a filler material in materials such as polymers, and particularly not by a scalable route that could afford large quantities.

There are approximately one million metric tons of graphite sold annually around the world, and there are roughly 800 million metric tons of untapped natural graphite that could be mined and used in the future, according to the U.S. Geological Survey. Graphite is used in a wide variety of applications such as those related to friction (brake linings are one example), in gaskets, as a lubricant, and as an electrode material in the making of steel.

Source: Northwestern University

Citation: Research paves way for new composite materials (2006, July 19) retrieved 21 September 2024 from <https://phys.org/news/2006-07-paves-composite-materials.html>

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