Graphene: The Modern Alchemist's Miracle

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Runes inscribed into stone walls appear in the dim light of a candle. Vials of mysterious elements are labeled with inscrutable handwriting. Stacks of parchment filled with equations and properties litter the floor. The alchemist leans over a sliver of The Stone, fusing it with molten lead. This priceless artifact, known to Aristotle as the philosopher's stone, should transform lead and iron into priceless materials. After centuries of research, scientists seem to have triumphed in their age-old quest to radically transform the material found in a pencil into a miraculous substance: graphene.

It began with two scientists hovering over a microscope, a blackboard once again filled with nonsensical structural diagrams and properties. This time, the table wasn't inscribed with runes or covered in mysterious vials of elements. No, it held scotch tape and graphite, the material used to create pencils found in any dollar store across the world. But it also held a wonder material, one that answered the alchemists' own call.

In 2004, two researchers at the University of Manchester, Andre Geim and Konstantin Noselov, created a simple method to isolate graphene: using Scotch Tape to peel off layers of graphite until only one remained. These layers are connected by van der Waals forces, relatively weak electric forces between atoms. This vulnerability allows tape to easily separate layers of graphite. But what makes one layer of graphite so different from graphite itself?

Unlike graphite, graphene is a transparent, pliable material that is 200 times stronger than steel. It can conduct electricity and heat, and unlike other conductive materials, it can be submerged in liquids without oxidizing. "All of these properties together are extremely rare to find in one material," said Dr. Vijayaraghavan, professor at the University of Manchester.

At the University of Texas, Allan MacDonald investigated the possibilities of two layers of graphene: What if they were closely aligned? he questioned. MacDonald discovered that rotating one layer decreases the flow of electrons, allowing for increased interaction. In fact, an angle between 1.0 and 1.2 degrees creates a superconductor, a material that conducts electricity indefinitely.

This attracted the attention of the EU, leading to the Graphene Flagship project, which produced a graphene roadmap with the most promising applications. This included energy storage, composites, and biomedical technologies. One creation is Perforene, a graphene based desalination filter that cuts energy usage by 20 percent. Another development is a graphene supercapacitor battery that can be charged in seconds without loss in performance, making electronically powered vehicles a more viable solution. Imagine charging a vehicle just as fast as filling it up with gas!

In the future, graphene may lead to experiments in which electronics are integrated with biological systems, such as "a graphene gadget implanted in you that could read your nervous system or talk to your cells," said Dr. Vijayaraghavan.

These ideas all arose from graphene, a wonder material seemingly created with a form of modern day alchemy. The future holds endless possibilities, waiting for the next alchemist to discover.

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