Can the "wonder material" live up to all the hype?

Physicists Andre Geim and Kostya Novoselev have been rightly praised for their isolation, in 2003, of graphene—sheets of pure carbon a single atom thick. Its existence had been pondered for decades, but many suggested it was too unstable to **survive**. The two Soviet-born researchers won the Nobel physics prize in 2010 for their **groundbreaking** work, **carried out** at Manchester University, which involved **peeling layers** of graphene from blocks of graphite. Both men, now British citizens, were knighted in 2012 for their **contribution** to science. Their work has won generous support from the British government and the European Union—in particular, the construction, at a cost of £61m ($92m), of the National Graphene Institute, which was opened by George Osborne, Chancellor of the Exchequer, in March.

The researchers now have another distinction to their credit: their **discovery** is about to become a commercial product. A graphene-based lightbulb which is said to be longer-lasting, more **efficient** and cheaper to make than today's **domestic** LED lamps will go on sale in a few months' time. Though graphene **flakes** have already been **incorporated** into tennis racquets, skis and conductive ink, the new lightbulb is claimed by its manufacturer—Graphene Lighting Plc, to be the first commercially viable consumer product based on the **material**.

That may be splitting hairs. Even so, going from discovery to commercialisation in little more than a decade is quick. Many **entrepreneurial** companies find that turning an invention into a successful **innovation** can take 20 years or more.

Graphene is not called a "wonder material" for nothing. Apart from its remarkable electrical properties (and also, thermal and acoustical properties), it is the thinnest and lightest **substance** known, as well as being the strongest (more than 100 times stronger than high-strength steel). As if that were not enough, graphene is also extremely flexible and almost totally **transparent**, absorbing only a **minuscule** amount of the light falling on it.

Some of the most **obvious applications** include rapid-charging lithium-ion batteries, better solar cells, printable electronics, foldable LED touchscreens, ultrafast molecular sieves, improved DNA sequencers, corrosion-resistant coatings, terahertz wave generators for extremely fast wireless communication, and, of course, more efficient lightbulbs. The list of proposals for future graphene products goes on and on, as researchers cozy up to **potential** sponsors.

Readers with long memories may notice how the **trajectory** which graphene is following **resembles** the one shown by carbon fibre back in the 1960s. Then, as now, the new material was seen as a wonder product that would have numerous **applications**. Then, as now, the British government felt it had a sacred duty to protect and promote what it perceived to be a **home-grown** invention—with the promise of jobs and exports.

Of the many applications suggested for carbon fibre, its promise to revolutionise air travel captured the most attention. With stronger, lighter fan blades, made from Hyfil instead of **aluminium** alloy or titanium, Rolls-Royce's latest aircraft engine at the time, the RB211, would have had a **significant** weight-saving advantage—and thus better fuel economy—over rivals from General Electric and Pratt & Whitney.

The **outcome** was rather different. While turbine blades made from Hyfil had all the tensile **strength**, and more, to withstand the centrifugal forces of a big fan engine at full power, their shear strength left much to be desired. The story of how compressor blades shattered when a frozen chicken was fired at them to simulate bird impact contributed to carbon fibre's fall from grace.

Meanwhile, the cost and **delay** involved in replacing the RB211's Hyfil blades with titanium ones plunged Rolls-Royce into bankruptcy. Britain's proudest engineering firm then had to be rescued at taxpayer expense. So much for governments picking winners. Hopefully, graphene will be spared a similar fate.

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