Graphene – a major discovery for use in medical science

Effective against brain injuries, strokes, multiple sclerosis, heart attacks ... and more

SINCE the accidental discovery (or perhaps more correctly, the mechanical obtainment) of the super material graphene in 2004 by researchers of the University of Manchester, applications within different scientific disciplines have exploded.

What makes graphene so special is that it is an exceptionally pure substance, which can mostly be attributed to its simple, orderly structure based on tight atomic bonding.

Since carbon is a non-metal, it might be expected that graphene is a non-metal too, but it behaves much more like a metal, which led some scientists to describe it as a semimetal or a semiconductor (a material mid-way between a conductor and an insulator, such as silicon and germanium).

Due to its amazing properties, this allotrope of carbon led to innovative developments in medicine, electronics, energy, telecommunications, transport, defence and many more fields.

Because all the characteristics of graphene are not needed for certain applications, researchers started to develop different types of graphene that are optimised for particular purposes. Some graphenes are optimised for electronic components due to their amazing electron-carrying properties.

Others make the most of the low-resistivity for the use in energy-saving power systems or the excellent transparency and conductivity for solar cells and computer displays. Graphene can also be optimised for structural use in composite materials.

Among all the remarkable applications and uses of graphene, the focus today is on its bio-medical applications. What makes graphene very suitable for bio-medical applications is that it has a high surface area and is a very versatile material. This means that almost anything can be attached to its surface.

Being able to fine-tune this material offers enormous design capabilities and is unprecedented among other nanomaterials.

In the bio-medical field, pristine (non-oxidised) graphene sheets, few-layer graphene flakes (FLG), and graphene oxide (GO) are particularly used due to their distinctive, versatile and tunable properties.

The Australian company, Dotz Nano, recently shared extensive research done by Rice University and four other universities and research facilities under the leadership of Professor James Tour. The research found that graphene quantum dots (GQDs) are effective in the treatment of brain injuries, strokes, multiple sclerosis and heart attacks.

GQDs are chopped fragments from a graphene sheet that gained significant interest in the biomedical world due to their distinctive and tunable photoluminescence properties, remarkable physicochemical properties, high photostability, good biocompatibility, and small size (diameter less than 10 nanometres).

Carbon-based nanomaterials are excellent collectors of reactive oxygen species (free radicals or unstable molecules containing oxygen) that often cause damage to DNA, RNA and proteins, and even cell death. The reactive oxygen species are an important contributing factor to cancer, stroke and cardiovascular disease.

The study proved that the coalbased low toxicity GQDs are very useful in uncovering diseases and combating oxidative stress in living mice. GQDs could thus assist in treating patients suffering from a range of serious medical conditions.
Another innovative use of graphene is in targeted drug delivery. The lateral dimensions of graphene can be adjusted between nanometres and millimetres, their thickness can be changed from one to hundreds of monolayers, and their flexural rigidity can also be altered, which makes graphene a very versatile material in drug delivery.

The flat surface of graphene can be easily functionalised to enable modification of the surface property from hydrophobicity (repelled by water) to hydrophilicity (attracted to water molecules). This is unparalleled among other nanomaterials, offering enormous design capabilities as a platform for drug delivery and ultrasensitive biosensors. Graphene even has the potential to change the behaviour of cells.

Graphene has, therefore, proved especially valuable in theranostics – a relatively new field of medicine, which combines very specific targeted therapy based on specific targeted diagnostic tests.

Single-walled nanotubes of graphene are already being used for intracellular delivery of anticancer drugs such as doxorubicin (an anthracycline chemotherapy drug extracted from the Streptomyces bacterium that slows or stops the growth of cancer cells) and siRNA (small interfering RNA used to control expression of a particular gene and to reduce the duration of chemotherapy).

Graphene further has the potential in cancer treatment to significantly lessen the side effects associated with current treatments.

Due to graphene’s large surface-to-volume ratio, unique optical properties, remarkable electrical conductivity, high carrier mobility and density, high thermal conductivity and many other unique characteristics, it has become the ideal material for biosensors and diagnostics.

Biosensors are typically used for the detection of analytes such as glucose, cholesterol, haemoglobin, and glutamate (a powerful excitatory neurotransmitter released by nerve cells in the brain that plays an important role in learning and memory).

Graphene has indeed opened up the possibilities of wonderful new applications in a variety of fields. Although still within the initial stages of development, graphene in biomedical applications has the potential to make a significant impact on people’s lives.

If we can succeed to manufacture it cost-effectively, it may certainly change the world of biomedicine for the better. LYFT’S hints that its cut-throat rivalry with US ride-hailing rival Uber is easing may prove bad news for customers, but it sent shares in both companies sharply higher on Thursday. With Uber set to report after Wall Street closes, analysts were excited by Lyft’s 72 percent rise in second-quarter revenue and its assertion higher spend per rider – read higher prices – would pull both third quarter and full-year sales above market expectations. Finance chief Brian Roberts said 2018 was likely the peak of losses for Lyft and said pricing had become “more rational”, meaning the company should spend less on the constant promotions and incentives it and Uber have used to win market share. At least nine brokerages raised their price targets on Lyft stock in response, with Credit Suisse the most bullish with a price target of $96 (R1 463). Shares of Lyft jumped 8 percent to $64.99 in trading before the bell, while those of Uber rose 4.2 percent at $41.35 as traders bet its results would produce a similar message. “While Lyft continues to spend aggressively on various initiatives, competitive pressure on rider incentives for core ride-sharing continues to ease, which is a sign of a rational duopoly between Lyft and Uber for the moment,” Piper Jaffray analysts said. “We believe Lyft will be both a catalyst and beneficiary of the growth of ride-sharing and autonomous tech over the next 10+ years.” Lyft and larger rival Uber, both loss-making, have historically given deep discounts to attract riders, and Wall Street’s concern over the associated costs has driven shares in both lower since their stock market launches earlier this year. Canaccord analysts said Lyft’s 22 percent expansion in revenue per rider in the quarter seemed to be driven much more by it reducing the incentives it gives to customers than any increase in numbers of riders. With the companies having faced protests in several US cities against efforts to lower driver costs, pushing ride prices higher has become vital for their efforts to gain investors’ faith in their longterm prospects. I Reuters