Graphene Based Heterostructures

BACKGROUND

In its purest form, graphene has exceptional room temperature electronic properties making it an attractive alternative to silicon for the electronics industry. For application in electronics, materials with high carrier mobility are more responsive and operate more efficiently. Graphene can achieve very high carrier mobility at room temperature and at liquid helium temperatures; it is expected to rival the best suspended-devices in terms of carrier mobility. However, devices made in this manner are known to be fragile. Sandwiching pristine graphene between layers of hexagonal boron nitride (hBN) lends protection to the suspended graphene device while maintaining its high carrier mobility. Bubbles caused by defects during the layer application process have previously been a problem, destroying the device performance. The proposed technology is a novel method that overcomes this problem along with others. This technology allows application of very thin layers of hBN to produce hBN-graphene structures which could be used in flexible electronics.

THE TECHNOLOGY

This technology is an hBN graphene heterostructure formed by encapsulation of a pristine graphene layer between two layers of atomically flat hBN crystals. This protects the graphene against the environment and has been shown to exhibit high carrier mobility at room temperature, which is anticipated to be even higher at liquid helium temperatures. This technology overcomes the functionality-destroying bubble formation problem, which is encountered upon layer application for making suspended graphene devices. Specific techniques involving precursor structures and sacrificial layers are used to reduce contamination and improve device performance. Using mass-produced precursor structures, it is possible to accurately apply very thin hBN layers around graphene. This can be used in flexible electronic applications.

KEY BENEFITS

- Exceptional electronic properties
- Higher carrier mobility, rivalling existing suspended devices.
- Protection of graphene against its environment.
- This technology allows suspended graphene devices to be built without bubble formation; hence device functionality is not compromised.
- The disclosed method allows accurate application of very thin hBN layers, allowing its use in flexible electronics.

APPLICATIONS

The technology can be used to make:

- Nanoelectronics - developing smaller, more efficient transistors, circuits, diodes and other electrical components.
- Flexible electronic screens as the thinness of the materials involved can be tailored to retain a great degree of flexibility.
- Transparent electronics.
- Micro-electromagnets (flexibility allows it to be wrapped around a microscopic magnetic core) which may have applications in HDD data storage or other magnetic applications.
- Micro-robotics where circuit boards may benefit from retaining flexibility, adding to their robustness.
- 'Blackbox' type applications for retaining information from the wreckage of vehicles.

The technology could be used in conjunction with other new technology advances such as plasmonics where it may be able to provide greater plasmon propagation distances.

The technology could be incorporated into 'wet' applications as the protection added by the hBN might be sufficient for hydrated environments.

INTELLECTUAL PROPERTY

Patent granted in Japan and USA, and pending in China, Europe and South Korea.

OPPORTUNITY

We are seeking co-development and collaboration opportunities.

CONTACT

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