Graphene Based Field Effect Transistor (FET)

BACKGROUND

The properties of graphene have made it a highly promising material for the development of next-generation electronics. To date however, the use of graphene as an alternative to silicon in the manufacturing of field effect transistors (FETs) has been hindered by the metallic conductivity of graphene and unimpeded transportation of electrons through barriers due to tunneling. As a result, the ON-OFF switching ratios are limited to approximately 1:1000. Whilst these relatively small energy gaps are sufficient for individual high frequency transistors and analogue electronics, they are not suitable for integrated circuits.

One possible solution to this problem is to introduce a band gap in graphene. However, previous efforts to achieve this have proven incapable of achieving sufficiently high ON-OFF ratios without impairing the electronic capabilities of graphene.

THE TECHNOLOGY

This technology is a graphene based FET that facilitates quantum tunneling between two graphene electrodes through an insulating barrier. The novel architecture demonstrated in these transistors is achieved by utilizing graphene hetero-structures that incorporate boron nitride or molybdenum disulfide as a tunnel barrier. Currently, the technology facilitates high tunnel currents and has a switching ratio of approximately 1:10000. However, this ratio could be optimised through further research.

KEY BENEFITS

- The increased switching ratio enables the use of graphene in FETs
- These graphene based FETs with an insulating barrier continue to demonstrate the high conductivity that is characteristic of graphene
- The transistors are only a few atomic layers thick, maximizing the scope for miniaturization of electronics and integrated circuits, whilst also improving response sensitivity when compared to silicon FETs.

APPLICATIONS

Potential applications of this technology include:

- Incorporation into computer processors, replacing the currently used silicon based metal oxide semiconductor field effect transistors (MOSFETs).
- The development of flexible touch screen technologies or into other pressure sensing applications, such as sensors used in robotics platforms.

- Switching analogue signals between paths (known as multiplexing), enabling the construction of nanoscale mixing boards.
- Use as an alternative to traditionally used FET amplifiers.
- Use in power control applications, such as switching internal combustion engine ignition coils
- Their incorporation into biosensors and chemical sensors, ensuring rapid, sensitive and specific readouts.

INTELLECTUAL PROPERTY

Patent has been granted in China (CN103493203) and the USA (US9318591 B2), and is pending in Europe (EP2689460 A2) and South Korea.

OPPORTUNITY

We are seeking a licensee or industrial collaborator to further develop this technology.

CONTACT

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