Review of: "Graphene in nMOS field-effect transistors is an excellent electrical conductor, and also has outstanding spintronic properties"

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Graphene in nMOS field-effect transistors is an excellent electrical conductor, and also has outstanding spintronic properties. The ultra-thin carbon lattice is capable of transporting electrons with coordinated spin over longer distances and spinning for longer periods of time than any other known material at room temperature. Although the distance is still on the scale of a few micrometers and the time is still measured in nanoseconds, it essentially opens up the possibility of using rotation in microelectronic components.

The high speed of switching (doping) in the nMOS transistor circuit of Graphene transistor is possible only because it can do p- and n (positive and negative) doping, and graphene doping is a main parameter in the development of nMOS transistor Graphene transistor. The bias voltage is applied to the graphene transistors in such a way that it always operates in its "active" region, that is, the curved or active linear part is used for the output characteristics. Graphene, which consists of only one carbon atom, can be used to create multilayer graphene field-effect transistors that consume less energy and take up less space.Graphene is a semi-conducting material with zero gap and not suitable for logic circuits, but using technology, they create different forms of this material that have different gaps. Graphene strips, multilayer graphene and graphene grown on different transistor layers are such forms.

> ***In the nano transistor structure, the electronic quantity that is more easily available is the ionization potential, and the ionization potential is greater in the size of the small grains of the nano structure (smaller particles), that is, as the size of the particles increases, their ionization potential decreases. Finds.***

An increase in the surface-to- volume ratio and changes in geometry and electronic structure have a strong impact on the chemical interactions of matter, and for example, the activity of small particles changes with changes in the number of atoms (and thus the size of the particles). Unlike today's nano-transistors, which behave based on the movement of a mass of electrons in matter, new devices follow the phenomena of quantum mechanics at the nano scale, in which the discrete nature of electrons cannot be ignored. By reducing all the

horizontal and vertical dimensions of the transistor, the electric charge density increases in different areas of the nano-transistor , or in other words, the number of electric charges per unit area of the nano-transistor increases.

This has two negative consequences:

First, with the increase in electric charge density, the possibility of electric charge discharge from the insulating areas of the transistor increases , and this causes damage to the transistor and its failure. This event is similar to the discharge of excess electric charge between the cloud and the ground in the phenomenon of lightning, which causes the ionization of air molecules into negative and positive ions. Secondly , with the increase of the electric charge density, the electrons may leave the range of the radius of one atom and enter the range of the neighboring atom's radius under the influence of repulsive or abduction forces, which have now increased in value. This is called tunneling in quantum physics. Electron tunneling from one atom to the adjacent atom is a phenomenon that happens a lot between electrons in small dimensions. This phenomenon is the basis of the work of some electronic components and some nanoscopes. But in nanotransistor, this phenomenon is not a useful phenomenon, because electron tunneling from one atom to the adjacent atom may continue and cause an electric current.

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