Review of: "(nanotransistor) tubes (nanoelectronics) (less than 01 nm)"

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Potential competing interests: No potential competing interests to declare.

Note: In the production, reproduction and improvement of nanotransistors, the manufacture of nanotubes is very important. For the manufacture of nanotubes, the most important difference is between methods based on gas and solid sources. In CCVD, low temperature is usually used and nanotubes are grown at temperatures below 0.111 degrees.

More than one mechanism can be involved in the growth of carbon nanotubes depending on the type of gaseous precursor, the catalyst used and the operating parameters. The mechanism of dissolution-infiltration-precipitation is one of the most common, which mostly prevails in low temperature methods. In this mechanism, catalytic nanoparticles of metal alloys or transition metals (such as nickel, iron and cobalt) are considered spherical or floating on the substrate surface. Hydrocarbon vapor (such as CO, CH₄, C₂H₂, C₂H₄ and C₂H₆) when it comes into contact with the hot particles of the catalyst, it decomposes into carbon and hydrogen, and the carbon penetrates into the substrate metal. When the carbon atom in the catalyst reaches a supersaturated value, the deposition and growth of carbon nanotubes begin. If the interaction of the catalyst if the substrate is weak, the metal has an acute contact angle with the substrate (nanotube at the bottom of the catalyst) (tip growth) and if the interaction of the catalyst with the substrate is strong and the metal has an open contact angle with the substrate, the nanotube grows at the top of the catalyst (growth base). In the first case, it is possible to produce a nanotube with an open end. The physical form of the deposited carbon nanotube, single-walled, multi-walled, amorphous, and the graphite layer covering the catalyst nanoparticles depends on many factors, such as the size of the catalyst particles, the deposition rate. When if the sedimentation rate is equal to or less than the carbon penetration rate, the graphite layer around the catalytic nanoparticles is formed. When the deposition rate is higher than the carbon penetration rate, carbon nanotubes are formed. The size of catalytic nanoparticles plays an important role in the growth of nanotubes, generally, catalytic nanoparticles with a small size (less than 01 nm) are active for the nucleation and growth of carbon nanotubes. If the particle size is about one nanometer, a single-walled nanotube is formed. Catalytic nanoparticles with a size of 01 to 51 nm lead to the growth of multi-walled nanotubes. Also, catalytic nanoparticles with a size larger than 51 nm are covered with amorphous graphite sheets.
Due to some unique physical properties, graphene has wide applications in the field of electronics. Among these properties, the mobility of charged particles inside graphene, or the same mobility represented by the letter $\mu$, is very important. The mobility value for graphene is $100,000 \text{ sV/cm}^2$, and the saturation speed is reported to be about $5 \times 10^7 \text{ s/m}$. The sum of these properties has made graphene as a strong conductor for electronic applications, including the use in transistors. In the production and reproduction of tubular nanotransistors, the methods of producing carbon nanotubes are divided into two general categories, methods based on solid and gaseous carbon sources. Generally, CCVD methods use a lower temperature to produce carbon nanotubes compared to solid carbon sources. Understanding the production mechanism of carbon nanotubes in order to optimize its characteristics is a very important approach in the production of nanotransistors. Many parameters, such as crystal grain size, substrate type and deposition rate, are involved in these mechanisms. The size of the catalyst is one of the important and influential factors on the characteristics of the produced carbon nanotubes, and by changing it, multi-walled and single-walled carbon nanotubes can be produced. Some methods, such as electric arc and mold, have the ability to produce carbon nanotubes in the absence of a catalyst, which lead to the production of products with higher purity.

**Conclusion:**

In the production and reproduction and promotion of nanotransistors, the manufacture of nanotubes is very important. For the manufacture of nanotubes, the most important difference is between methods based on gas and solid sources. In CCVD, low temperature is usually used and nanotubes are grown at temperatures below 0111 degrees.

References


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