APPLICATION OFCARBON NANOTUBES

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During the last years carbon nanotubes have attracted a great interest of world scientists. Nowadays researchers study their properties, perform the experiment in the laboratories anddevelop a set of theories about their practical application.

Carbon nanotubeis an elongated cylindrical structure with a diameter of one to several tens nanometers and a length of several centimeters, consisting of one or more rolled up into hexagonal graphite planes with generally hemispherical head. Nanotubes are members of the fullerene structural family. Their name is derived from their long, hollow structure with the walls formed by one-atom-thick sheets of carbon, called graphene. These sheets are rolled at specific and discrete ("chiral") angles, and the combination of the rolling angle and radius decides the nanotube properties; for example, whether the individual nanotube shell is a metal or semiconductor.

The intrinsic mechanical and transport properties of carbon nanotubes make them the ultimate carbon fibers.Thermal and electrical conductivity are also very high, and comparable to other conductive materials. Overall, carbon nanotubes show a unique combination of stiffness, strength, and tenacity compared to other fiber materials which usually lack one or more of these properties.

For example,scientists are trying to developa theory aboutthe construction ofa cablefora space elevator: nanotubescan holdtremendous weight-up to a tonper squaremillimeter.However, they can't receive long enough carbon tubewith a wall thicknessof one atom. The filaments, woven from the relatively short nanotubes can be used, but they reduce the finalstrength.

One of the interesting applications of carbon nanotubes in future is the idea of creation the nonvolatile random access memory (NRAM). The silicon substrate is applied to thin insulating membrane of silicon oxide.The conductive electrodes (130 nm), separated by insulating layers, are placed along the width of the membrane.Over electrodes are arranged nanotube arrays which are closed on both sides of the conductive contacts. In the normal state (state OFF) nanotubes do not touch the electrodes and are above them at a height of about 13 nm. If the voltage is applied to the lower electrode, the nanotube under the influence of an electric field will bend and touch the lower electrode. However, this state (state ON) is stable due to the balance between mechanical stress and Van der Waals forces. Thus, by varying the voltage on the electrode we will obtain two stable mechanical states of nanotubes, one of which has a contact with the electrode, and the other - no. One of these states will respond to a logical zero and the other - the logic unit. In order to readthe contents ofthe memorycell it will be necessary to analyze it's state. If thememory cellis in the stateOFF, the electrical circuitisopenand the voltagewill be high,which corresponds toa logic one. If thememory cellis in theON,i.e.there is contactbetween the nanotubeand the lower electrode, the circuit is closedand the voltageis low, corresponding to logic zero

In comparisonwith traditionalmemory types, NRAMmemoryhas several advantages.First, despitethe factthat thisRAM-memory, it isvolatile.Secondly, according to the companyNantero,the information recordingdensityin the devicescan reachNRAM5 billionbits per squarecentimeter (several times greater than thecurrentmemory chips), and the memory operating frequency-to 2GHz.

The small dimensions, strength and the remarkable physical properties of these structures make carbon nanotube a very unique material with a whole range of promising applications in different areas.The usefulness ofnanotubesis evident. However, the developmentand introduction ofnanotubesinto everyday lifeis complicated bya lackof knowledge, complexity andhigh costof production.

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