(Nano Telecommunications) More Familiarity With the internal Structure of Microstrip Antennas

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- **Abstract:**

- Accordingly, if the antennas used in nano-components are to be within this range, it should be expected that the electromagnetic waves used in the communications of these systems and devices will be around several tens of terahertz, which will include wavelengths in the infrared, visible, and ultraviolet regions.

- **Keywords:** Nanocommunications , terahertz , electromagnetic waves , nanoantenna

Introduction •

Antennas are considered as the primary means of absorbing electromagnetic waves in space and have their own engineering knowledge, which is very developed and extensive. In general, in order to receive electromagnetic waves in space, the dimensions of the antenna must be on the order of the wavelength entering its surface. Given the very small dimensions of nanosensors, nanoantennas need to have a very high operating frequency in order to be usable. The use of graphene helps to solve this problem to a large extent. The propagation speed of waves in CNTs and GNRs can be up to 100 times lower than its speed in vacuum, and this is related to the physical structure, temperature and energy. Accordingly, the resonant frequency of graphene-based nanoantennas can be two orders of magnitude lower than that of nanoantennas based on nanocarbon materials. It has been proven mathematically and theoretically that a quasi-metallic carbon nanotube can have terahertz radiation when a time-varying voltage is applied to its sides. One of the most important parameters of any nanoantenna is the current distribution on it. This characteristic determines the radiation pattern, radiation resistance and reactance, and many important properties of the antenna. Despite the possibilities of manufacturing nanotubes with a length of several centimeters, it is possible to manufacture electrical conductors with a length to width ratio of the order of 10^7 . Nanotube antennas at first glance give us the impression that they are similar to a dipole antenna designed in small dimensions. But in fact, this is not the case. In the main theory of dipole antennas to determine the current distribution on the antenna, the dipole radius is larger than the skin depth and the resistance losses are so small that they can be ignored. Given that the nanodipole L/d is significantly reduced, it becomes unusable. In one-dimensional electrical conductors such as nanotubes, the skin depth mode is completely eliminated. Because here the electrons are only allowed to move along the length of the conductor, and so the current distribution is effectively one-dimensional. In addition to the fact that the electrons move in only one dimension, two other important issues arise: large inductance and resistance. These features give nanotube antennas a very different behavior than classical antennas. The main difference is that the current distribution is alternating with a wavelength that is 100 times smaller than the free-space wavelength for a given thermal frequency. The wavelength of the current distribution depends on the wave speed in that mode. If the wave speed is the speed of light, the wavelength of the current distribution is the wavelength of electromagnetic waves in free space. On the other hand, the wave speed in nanotubes is about a hundred times slower than the speed of light. This is because in circuit theory, the wave speed is equal to the inverse square root of the capacitive capacitance per unit length multiplied by the inductive capacitance per unit length. The kinetic inductance per unit length of a nanotube is ten thousand times greater than the magnetic inductance per unit length of conventional antennas. Therefore, the wave speed will be 100 times smaller than the speed of light. The efficiency of a classical nanotube antenna is of the order of -90 dB, which will be due to resistive losses. This is while the dimensions of the antenna and the nanosystem or nanosensor assembly, the operating frequency, power losses, the range and dimensions of the sensor network, the structure and facilities of the power supply system and the physical communication platform between the different parts of a nanosystem are major factors and parameters, each of which is in some way decisive and determines the manufacturing capability and performance of the final system.

• (Nano Communications) Nano Strip Antennas

One of these new areas and functions of nanotechnology is nanoantennas, which are used in various fields such as nanosensors, communication nanonetworks , electrical energy generation and other similar topics and are considered as one of the current areas of nanotechnology development. At the nanoscale, graphene-based antennas are used to transmit EM waves. Graphene is a very thin single-atom sheet of confined carbon atoms placed on a crystal lattice . Given the very small dimensions of nanosensors, nanoantennas need to have a very high operating frequency to be usable. However, the use of graphene helps to solve this problem to a large extent. The nanonetwork has greater communication and processing potential that overcomes the limitations of independent nanodevices through the cooperation of nanodevices.With the development of nanoscale device manufacturing technology, it has become possible to manufacture nanoantennas and use them in various applications. Communication between nanodevices is a fundamental challenge related to the development of nanoantennas and related electromagnetic receivers. Reducing the size of traditional antennas to hundreds of nanometers leads to very high operating frequencies . At THz band frequencies, the very large bandwidth available leads to much higher path loss than lower frequency bands . The issue of designing and manufacturing antennas that can be used in nanosystems and even introduce new functions to the industrial world is very important and has become a new topic in the electrical industry and nanotechnology. Since nanoantennas have a wide angular absorption capability, their efficiency is maintained to a significant extent even in the case of oblique solar radiation to the surface of the solar panel . This system can also absorb energy radiated from the Earth, or terrestrial radiation, which is caused by the daily radiation of the sun to the Earth's surface and occurs at wavelengths of 10 micrometers , i.e. frequencies of about 90 terahertz.

(Nanocommunications) Microstrip Antennas •

A microstrip antenna consists of a very thin metal strip placed on a ground plane with a dielectric material in between. The radiating element and feed lines are photo-etched onto the dielectric material. Typically, the patch or microstrip is chosen to be square, circular, or rectangular for ease of analysis and fabrication. Microstrip antennas are increasingly useful because they can be printed directly onto a circuit board . Microstrip antennas are low cost, have low specifications, and are easy to fabricate. The microstrip antenna is fed by a microstrip transmission line. The antenna, microstrip transmission line, and ground plane are made of a highly conductive metal (usually copper).The microstrip antenna should have a length equal to half the wavelength in the dielectric medium (substrate). The width of the microstrip antenna controls the input impedance. A larger width can also increase the bandwidth. For a square patch antenna fed in the above manner, the input impedance will be about 300 ohms. By increasing the width, the impedance can be reduced. However, to reduce the input impedance to 50 ohms, a very wide microstrip antenna is often required, which takes up valuable space. The larger width controls the radiation pattern. The bandwidth of a microstrip antenna is very small. Rectangular microstrip antennas are generally narrow. The bandwidth of rectangular microstrip antennas is typically 3%. Second, the microstrip antenna is designed to operate at 100 MHz, but it resonates at about 96 MHz. This change is due to the fringe fields around the antenna, which makes the microstrip antenna appear longer. Communication between nano-devices is a fundamental challenge related to the development of nano-antennas and the corresponding electromagnetic receivers. Reducing the size of traditional antennas to hundreds of nanometers leads to very high operating frequencies . At THz band frequencies, the very large bandwidth available leads to much higher path loss than at lower frequency bands.

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(Nano-communications) Dimensions of nano-antennas and nano-communications systems •

The dimensions of the antenna and the nanosystem or nanosensor assembly, operating frequency, power losses, range and dimensions of the sensor network, structure and capabilities of the power supply system, and the physical communication platform between the different parts of a nanosystem are major factors and parameters, each of which is decisive in some way and determines the manufacturing capability and performance of the final system.

Nano-network is a nano- scale communication network between nano-devices. Nano-devices face special challenges in performance due to their limited processing and power management capabilities . Therefore, these devices are expected to perform simple tasks that require different and novel approaches. In a molecular communication system, the transmitter sends information by chemical molecules called information molecules, and after being emitted into the environment, it is received and decoded by the communication receiver.A network of communication nanoparticles can cover a wider area and perform more network processing . In addition, there are several nano-communication technologies that require the use of external excitation and measurement to work. Wireless communication between nano-networks and micro- and macro-devices and equipment can meet this need.

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Conclusion: •

The dimensions of the antenna and the nanosystem or nanosensor assembly, operating frequency, power losses, range and dimensions of the sensor network, structure and capabilities of the power supply system, and the physical communication platform between the different parts of a nanosystem are major factors and parameters, each of which is decisive in some way and determines the manufacturing capability and performance of the final system.

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