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SIMULATION OF THE CARBON NANOTUBES IN THE TERAHERTZ FREQUENCY

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Abstract

Since little is known isolate a sheet of carbon-graphite one atom thick. This crystal is two-dimensional graphene has remarkable electronic transport properties, which are neither those of a metal nor those of a semiconductor. In this paper we have developed a novel structure electromagnetic band gap (EBG), with a periodic arrays of carbon nanotubes presented, by introducing a multiwalled carbon nanotubes like a metallic via holes. The electromagnetic band gap (EBG) surface, also referred to as a photonic band gap (PBG) surface, has attracted extensive studies, In the optical domain, microwave and millimeter-wave areas[4]. The method used is an integral method based on the concept of waves (WCIP).

Keywords: EBG, Via Holes, WCIP, Therahertz;

1. **Introduction**

Molecular electronics is an emerging nano physics, promising to make new types of devices useful for both information storage quantum information. Among the nanostructures considered for the construction of a molecular electronics, the carbon nanotube is presented as a particularly promising candidate. Since the articles reference S.Iijima early 90s, carbon nanotubes have been extensively characterized and found to be very interesting for the development of nanoelectronics due to their many remarkable properties. Nanotubes are nanometer diameter cylinders micron length, which can be seen as the winding of a sheet of graphite. Their cylindrical shape and the particular electronic structure resulting make a rare experimental realizations of one-dimensional electronic system. The carbon nanotube is characterized by the helicity and the diameter of the tube, since these two parameters determine the periodic boundary conditions of the electronic wave functions. In this work we develop a new iterative method based on wave concept (WCIP) to model a forest of multiwalled carbon nanotubes(MWCNT) fig1.

2. Method and formulation

Multiwall carbon nanotubes sheet (MWCNT) consist of multiple graphene sheet (2 to 50) rolled around each other. For this work, we chose multiwalled carbon nanotubes with diameters around of 20 and 50 nm. As it was mentioned above the method is iteratively WCIP which is an integral method based on the concept of waves for solving diffraction problems and analysis of electromagnetic planar circuits. This method relies on the manipulation of incident and reflected waves instead of electromagnetic field [3]. Ease in this method is the implemented in the absence of test functions and fast computation time mainly due to the use of the fast transformation Modal (FMT).The structure can be formed by two elementary cells one with metallic via hole in its center and the other without anything. Fields are supposed to be oriented along z-axis and independent of z. we have the electric fields and current densities in functions of the incident waves A_i and the reflected waves B_i :

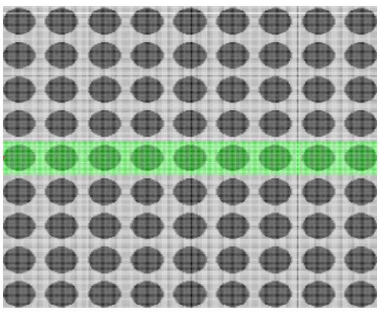

Fig.1 Structure with via holes carbon nanotubes

$$E_i = \sqrt{Z_{0i}}(A_i + B_i) \qquad J_i = \frac{1}{\sqrt{Z_{0i}}}(A_i - B_i) \qquad Z_0 = 120\pi$$

Where : Z_0 is arbitrary impedance chosen equal to the free-space impedance.

The nanotube structure is determined by the pair of integers (m, n) defining a feature vector of the winding called vector of chirality[1] [2]:

$$\overrightarrow{C_h} = n\overrightarrow{a_1} + m\overrightarrow{a_2}$$

$$d_t = \frac{C_h}{\pi} = a_{c-c}\frac{\sqrt{3}\sqrt{(n^2 + nm + m^2)}}{\pi}$$

$$a_{c-c} = 1.42\ \text{Å}$$

3. Results and discussion

The multi wall carbon nanotubes (MWCNT) constituting the metallic via holes are located between two excitations sources and are regularly spaced by a distance of 10 μm their diameter is 50nm. Figures are obtained for a number of via holes NXN = 8X8. Figures 2 (a) and (b) show the electric field distribution and the current density , and figures 3(a) and (b) show the coefficient of the transmission and of the reflection for the structure EBG of electromagnetic band gap formed by carbon nanotubes.

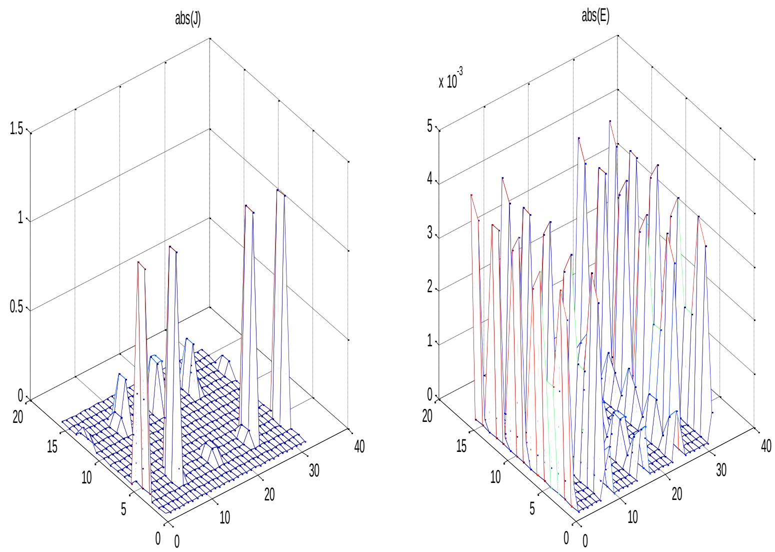

Fig.2 (a) Distribution of the current density. (b) Distribution of the electric field.

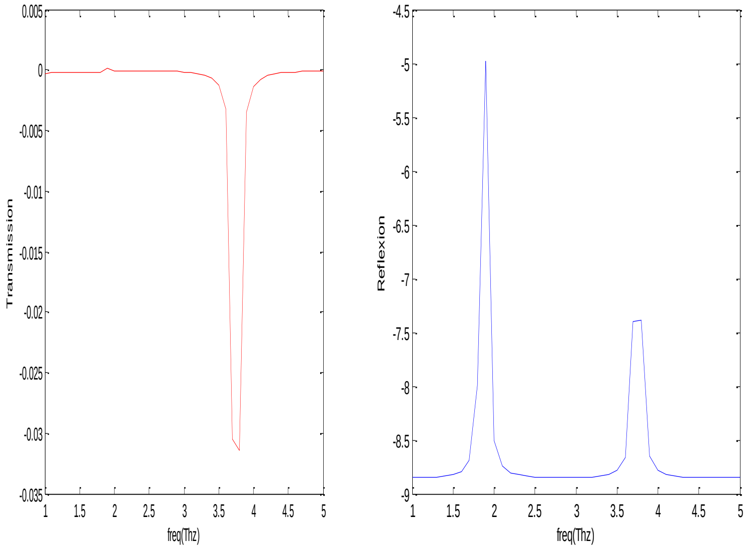

Fig.3 (a) Coefficient of the transmission. (b) Coefficient of the reflection.

4. Conclusion

The electromagnetic band gap have emerged as a new class of periodic dielectric structures where. Created from periodic nanotube of carbon (dielectric and/or metallic) structures these materials are characterized by a band of frequencies where no propagating modes exist. The WCIP method allows the characterization of these structures, and demonstrates the benefits of these applications in hyper frequencies.

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