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Graphyne implementation on a microstrip patch antenna terahertz telecommunications.

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Abstract:

The discovery of Graphene attracted the attention of the scientific community due to its excellent physical properties, such as excessively high electron mobility [1]. These discoveries opened a field of exploration of two-dimensional (2D) materials. Researchers have demonstrated that making a twist in the xy plane of one of the layers of a 2D material in relation to another superimposed layer of its electronic structure is sufficient to create a new material, with a different molecular bond and electronic structure [2]. These materials are characterized as 2.5 D and have different properties than the original materials, opening a new line of materials. Of these new materials, recently, two types of Graphyne were synthesized, one of them called γ-Graphyne [3] their hybridization sp and sp2 make them prospective for electrical applications, graphyne has been suggested as a viable material for a variety of applications in semiconducting and optical properties. In this work we report a study the implementation γ-Graphene geometry **Figure 1** on a microstrip patch antenna. We will theoretically show a route to obtain optical properties such as permittivity, and the numeric calculation of the permeability and electrical conductivity. Using density functional theory (DFT) the characteristic of the π and π* subbands with a gap of *0.49 eV* indicates the transmission of electrons under high polarization.Optical properties in its permittivity, it presented a high charge storage capacity around 100 and the calculation indicated a high capacity to withstand the formation of a magnetic field within itself around 2.6, for conductivity calculation, γ-Graphene exhibits a high rate 2.500S and is therefore capable of transmitting greater information (data traffic). These results are in line with literature results and indicate a possible greater efficiency for antenna design when compared to graphene antennas.The analysis of antennas made from graphene shows that this material can be used in thepatch of a microstrip antenna in the THz band [4].The way society creates, shares and consumes information has caused data traffic to acquire a new dynamic, where state-of-the-art communication systems, such as ultra-wideband (UWB) or millimeter wave (mmWave), are ineffective, due to its limitation in data transfer at a limit of up to 10 Gigabit per second (Gbps), making it unable to handle transmissions at higher information rates [5]. Therefore, the Terahertz (THz) band, which covers frequencies between 0.1 THz and 10 THz, stands out as an alternative, as wireless technologies will be able to support Terabit per second (Tbps) links (data transmission channels), and differs from other bands, as THz offers less loss, as low signal attenuation is obtained in atmospheric conditions, such as fog, dust and rain [6]. Therefore, it is necessary to implement a robust communication system, making the most of the characteristics of the THz band [7]. Microstrip antennas offer advantages for this application as they are more versatile when compared to other antennas with the same function. However, these

antennas have some disadvantages such as low efficiency, among others. Therefore, it is important to use some techniques to improve parameters such as changing the material of its components and geometric changes of the antenna [8]. Therefore, this work seeks to study the behavior of γ-Graphyne in a microstrip antenna. We show the electronic, geometric and optical properties of γ-Graphyne were investigated by density functional theory and Kubo-Greenwood formalism. The optical properties are necessary in the future, once the antenna will be implemented in a simulator that performs Multiphysics modeling. The optical parameters obtained indicate that the antenna will be able to operate at the THz frequency, in an improved way, since theorists emphasize that the γ-Graphyne and its electronic and magnetic properties. It has greater stability than graphene, so its application will allow advances in terahertz telecommunications technology.

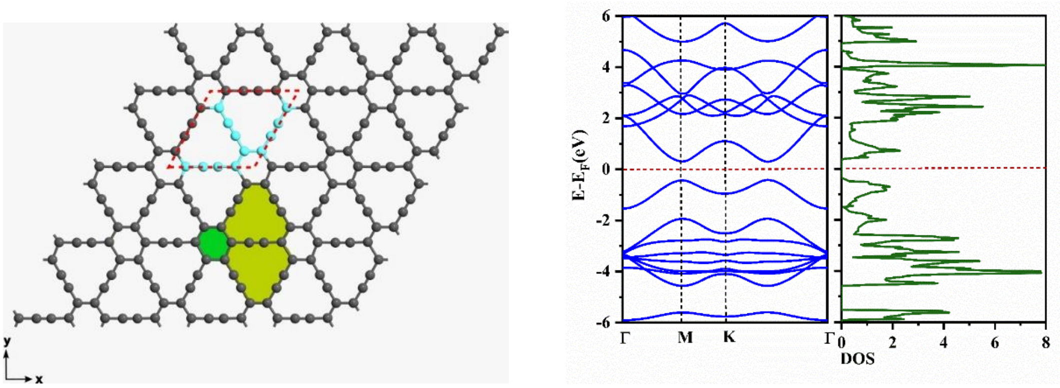

Figure 1: 2-D crystal lattice, unit cell (dashed rectangles), BS and DOS optimized via DFT/GGA-PBE/DZP for (a) and (b).

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