Transport properties of graphene ribbons with a random distribution of side attached benezene-like molecules.

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In the last years graphene and graphene nanoribbons (GNRs) have attracted a lot of scientific attention. The special and novel electronic properties together with the mechanical stability of this structures, even at room temperature, have suggested many possible applications in science and technology [1]. One of these applications is related with the capability of graphene layers to detect molecules absorbed or attached to the systems. There are several experimental reports concerning with the detection of different types of absorbed molecules in the system, such as nitrogen dioxide, nitrogen trioxide, water, etc. [2, 3]. An interesting experimental evidence is the detection of aromatic molecules in graphene layers. By measurements of the transport properties of a single layer graphene-based field effect transistor, it has been studied the effects of these aromatic molecules in the systems. It has been shown that these molecules are strong binding to graphene through π-π bonds between the molecular aromatic rings and the graphene, and therefore, are easily detected by the device [4].

In previous works, we have studied the effects of a single and a finite number of side attached molecules to graphene ribbons. We have found that the energy spectrum of a single molecule is reflected as a series of Fano antiresonances in the conductance curves of the system [5]. Besides, we have studied the effects of attach two molecules of different length to armchair GNRs. We have found that it is possible to identify the corresponding spectrum of each molecule from the Fano antiresonances of the conductance of the systems [6]. Finally, we have studied the effects on the transport properties of zigzag and armchair GNRs at which a finite number of molecules are side-attached in a periodic sequence. We have studied the conductance gap modulation as a function of the length of the molecules, the relative distance between them, and the number of attached molecules [7].

In this work we show a theoretical study of the electronic transport properties of GNRs at which linear benzene-like molecules have been side–attached at the ribbons edges in a random distribution. All the considered systems have been described using a single band tight binding hamiltonian. Based on the Green's function matching formalism within a real-space renormalization technique, we have calculated the local density of states and the electronic conductance of these systems.

We have considered two different systems: i) a long pristine graphene ribbon with molecules attached in both edges, and ii) two finite graphene ribbons parallel between each other, conected to metallic leads. In the latter system the molecules are attached between these parallel ribbons as molecular "bridges".
We have considered different scenarios taking into account different lengths and molecular concentrations. The random distribution imposes a disorder potential to electrons in the system. This extra potential produces a localization of the electronic wavefunction inside of the conductor which is characterized by a localization length. We have focused in the study of the

dependence of the localization length with the type of molecule, and on the concentration of this external perturbation [8].

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