Potential applications in optoelectronics had generated a great interest on the study of graphene optical properties. Along with this, the graphene has exceptional properties such as high mobility and optical transparency, flexibility, robustness, among others. Due to these properties, graphene can be used in different devices, among them transparent conductors, organic light-emitting diodes, photodetectors, touch screens, saturable absorbers and ultrafast lasers [1]. A transfer matrix method [2], is developed in order to obtain the optical properties such as reflection, transmission, and absorption in the far-infrared region. The superlattice structure was built by intercalating graphene sheets between two consecutive dielectrics $[\varepsilon_0 - (\varepsilon_1 - g - \varepsilon_2) - \varepsilon_0]$, where $\varepsilon_0$ represents the vacuum dielectric constant, $\varepsilon_1$ ($\varepsilon_2$) the dielectric constant for media 1 (media 2) and $g$ the graphene sheet. The graphene sheets were described by the optical conductivity taking account the interband and intraband transitions given by Falkovsky [3], in the case when the chemical potential for graphene ($\mu_g = 0.15 \text{ eV}$) is greater than $kT$ energy, which corresponds to the far-infrared region. It was found that the spectra-structure depends strongly on the number of superlattice period, the width of the different dielectrics and the optical contrast between $\varepsilon_1$ and $\varepsilon_2$ (dielectric contrast). However, its important to highlight that the transmission spectra for an incident angle of 45 degrees practically does not present any oscillations for TM-polarization independent of the period of the superlattice, as happens with the TE-polarization. For other incident angles, the transmission for TM its greater than the corresponding one for TE polarization. On the other hand, the absorption spectra are enhanced as we increase the number of the layers in the superlattice, reaching values about 70% for 59 graphene sheets. The absorption spectrum presents well-defined bands.

Keywords: graphene superlattice, dielectric-graphene-dielectric, optical properties

References:


Presenting author’s email: jmadrigal.melchor@fisica.uaz.edu.mx