Strain effect on the electronic properties in graphene

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Within the tight binding approximation, we study the dependence of the electronic band structure and of plasmonic spectra of a graphene single layer on the modulus and direction of applied uniaxial strain. While the Dirac cone approximation, albeit with a deformed cone, is robust for sufficiently small strain, band dispersion linearity breaks down along a given direction, corresponding to the development of anisotropic massive low-energy excitations. We recover a linear behavior of the low-energy density of states, as long as the cone approximation holds, while a band gap opens for sufficiently intense strain, for almost all, generic strain directions. Our calculation of the dielectric function is based on the random phase approximation (RPA), besides we consider local field effects (LFE), following the method developed by Hanke and Sham for the calculations of the dielectric response properties of crystalline systems. In this way we will take into account possible collective excitations of any wavelength as a function of the uniaxial strain.

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