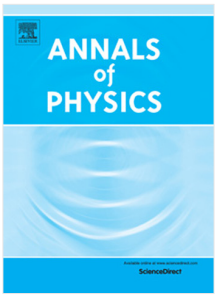
Accepted Manuscript



Magnetic field-, strain-, and disorder-induced responses in an energy spectrum of graphene

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PII: S0003-4916(18)30243-4
DOI: https://doi.org/10.1016/j.aop.2018.09.004
Reference: YAPHY 67753

To appear in: *Annals of Physics*

Received date : 23 February 2018
Accepted date : 3 September 2018

Please cite this article as: I.Y. Sahalianov, T.M. Radchenko, V.A. Tatarenko, Y.I. Prylutskyy, Magnetic field-, strain-, and disorder-induced responses in an energy spectrum of graphene, *Annals of Physics* (2018), https://doi.org/10.1016/j.aop.2018.09.004

Magnetic field-, strain-, and disorder-induced responses in an energy spectrum of graphene

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Abstract

We study numerically a role of the uniaxial tensile strains and disordered defects in their impact on electronic density of states (DOS) in graphene exposed to an external magnetic field. The DOS curves are calculated using the tight-binding Hamiltonian, where the perpendicular magnetic field and uniaxial tension are included via the relevant modifications of the hopping parameters. Observed non-equidistant Landau levels (LLs) in the energy spectrum of a defectless graphene undergo the displacement towards the non-shiftable zero-energy Landau level (LL), thus they get contraction as the uniaxial tension is applied independently on the stretching direction. The presence of both point and extended defects reduces LLs peaks, broadens, smears, and can even suppress the LLs depending on a degree of disorders, their strength, and largely effective ranges. Splitting of the zero-energy LL is observable in case of a short-range disorder. Alteration of the localized electronic states in graphene is sensitive to the axis of strain: the uniaxial tensile strains along armchair- and zigzag-edge directions can result to competing phenomena associated with enhancement and reduction of the DOS, respectively. Mutual action of the perpendicular magnetic field and uniaxial stress along the zigzag-edge direction in graphene contributes to the band gap observed in its energy spectrum: the gap becomes more pronounced and even wider as compared with that emerges in case of a zigzag strain effect only, i.e. beyond magnetic field effect.

Keywords: graphene, defects, strain, magnetic field, density of states
PACS: 61.72.Bb, 68.65.Pq, 71.70.Di, 81.05.ue
2000 MSC: 81U35

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