Nonlocal vibration of a nanoplate influenced by in-plane magnetic field using finite element method

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Recent advances in the field of nano-science are increasing the number of theoretical studies investigating the mechanical behavior of nanostructures and nanocomposites using nonlocal continuum models. Such models show to be an efficient tool to describe the vibration or stability behavior of nanoplate, nanobeam or complex nanostructure systems without any specific demands for computational resources. Using this theory, nonlocal effects such as long range interactions and forces between atoms are included via single material parameter also called nonlocal parameter whose values are usually calibrated with molecular dynamics simulations or using dispersion curves of atomic models. Nonlocal theory is convenient to include into a model various external field effects such as magnetic or temperature field on the mechanical behavior of nanostructures. In this paper, we analyze the free transverse vibration of a nanoplate model representing the graphene sheet nanostructure that is subjected to the influence of in-plane magnetic field. Governing equation of a nanoplate is derived employing the nonlocal elasticity theory of Eringen, Kirchhoff–Love plate theory and Maxwell classical equations. Finite element formulation for the magnetically influenced nanoplate is proposed to find the solution for natural frequencies of the system for different boundary conditions. Results obtained via finite element method are confirmed with other results from the literature. Influences of nonlocal parameter and the magnitude of magnetic field on natural frequencies are investigated through several numerical examples of graphene sheet nanostructure. This study can be useful for future research of more complex nanoplate based systems.

Thermal smearing of the magneto-Kohn anomaly for Dirac materials and comparison with the two-dimensional electron liquid

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We compute and compare the effects due to a uniform perpendicular magnetic field as well as temperature on the static polarization functions for monolayer graphene (MLG), associated with the Dirac point, with that for the two-dimensional electron liquid (2DEL) with the use of comprehensive numerical calculations. The relevance of our study to the Kohn anomaly in low-dimensional structures and the Friedel oscillations for the screening of the potential for a dilute distribution of impurities is reported. Our results show substantial differences due to screening for the 2DEL and MLG which have not been given adequate attention previously.