OPTICAL AND ELECTROMECHANICAL PROPERTIES OF GRAPHENE AND CARBON NANOTUBES VIA A TWO-FIELD ELASTIC FORMALISM

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Mindlin [1] showed that a continuum endowed at each point with an internal displacement field results in a theory that includes the optical lattice modes. In that spirit, we present a two-field continuum elastic formalism built on the symmetries of the honeycomb lattice, in which a set of previously disparate experimental and numerical results for graphene and carbon nanotubes can be understood in an unifying framework and further broadened.

Optical bands in graphite and nanotubes, the hexagonal Brillouin zone in graphene, phonons spectra beyond the long-wavelength regimen, and Raman active optical modes can all be correctly predicted by the two-field formalism, while they are inaccessible to the widely used continuum approach.

The delicate electronic structure of carbon nanotubes is very sensitive to mechanical disturbances, and new kinds of deformations, which are not allowed in bulk systems, are possible. By taking into account all of the degrees of freedom in the honeycomb lattice, the two-field formalism is well suited for studying electromechanical effects in carbon nanotubes, such as strain-induced band gap opening, or gap-gap induced phonon softening.

References

[1] R. D. Mindlin in ”Mechanics of Generalized Continua, Proceedings of the IUTAM Symposium”, 312-320, Springer-Verlag New York (1968).

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