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Valley polarization in graphene via out-of-plane deformations[1]
DAWEI ZHAI, NANCY SANDLER, Ohio University — The low energy dispersion of graphene shows a conical valley structure with the conduction and valence bands touching at the Dirac points. The existence of two inequivalent Dirac points, thus two valleys, suggests that they may be used as new degrees of freedom to carry information. However, existing proposals based on different mechanisms for achieving valley separation in graphene remain challenging for experimental verification. In this work we investigate graphene with out-of-plane deformations- one of the most naturally occurring and practically realizable settings, as a candidate system to produce valley polarization. Specifically, we consider local Gaussian bumps and extended Gaussian folds. In the first case, the corresponding local strains serve as scattering potentials for electronic states. A second-order Born approximation calculation based on the continuum model reveals the existence of valley polarization. While in the second case, the strains serve as magnetic barriers, which has distinct impacts on the transmission of electrons from different valleys. The valley polarization shows dependence on the geometrical parameters of the deformations in both cases. The efficiency of valley polarization for different geometries and energies will be discussed.

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Dawei Zhai
Ohio University

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