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Bending instability of few-layer graphene embedded in strained polymer matrix

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Аннотация:

In this Letter we describe analytically and simulate numerically the softening of flexural surface acoustic waves, localized in the plane of few-layer graphene embedded in soft matrix of low-density polyethylene. The softening of surface acoustic wave is triggered by the compressive strain in the matrix, which results in compressive surface stress in the few-layer graphene. Softening of the flexural surface acoustic wave leads to spatially periodic static bending deformation (modulation) of the embedded nanolayer with the definite wave number. Few-layer graphene with different numbers of graphene monolayers is considered. We describe the different models of interlayer bonding of graphene monolayers in a few-layer graphene, which correspond to the weak and strong interlayer bonding. The considered models give substantially different scaling of the wave number of periodic bending deformation and of the threshold compressive strain in the matrix as functions of the number of graphene monolayers in the few-layer graphene. Both the wave number of periodic bending deformation and the values of the threshold compressive surface stress in the few-layer graphene and of the compressive strain in the matrix are very well confirmed by the numerical simulations. Bending instability of few-layer graphene can be used for the study of bending stiffness and two-dimensional Young modulus of the graphene nanolayers, embedded in a soft matrix.

Ключевые слова:

Bending modulation wavelength, Bending stiffness, Few-layer graphene, Two-dimensional young modulus