Theoretical study on the directional motion of a nano-object driven by inhomogeneous strain

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Abstract

Directional transport of an object is essential in enabling desirable functions, especially in nanotechnology. It is very important in designing novel devices and machines, and has a wide range of potential applications in fields such as micro/nanofluids and MEMS/NEMS. In recent study, directional motion of a nano-particle driven by strain gradient field in substrate is found by MD simulation. However the motion mechanism underlying such the transport is unclear. In the present paper, theoretical models are established to study the motion of a graphene flake or a carbon nanotube on a graphene substrate driven by inhomogeneous strain. Different strain gradient are considered, including strain distributing with linear function, power function and exponential function. It is found that a driven force induced by the unbalanced van der Waals interaction is applied on the graphene flake or carbon nanotube, which can lead to slide of graphene flake or rolling of carbon nanotube on the substrate. The larger of the strain gradient is, the stronger of the driven force. The derived theoretical results are well consistent with the existing numerical simulations.

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