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Unconventional negative magnetoresistance in corrugated graphene

Abstract

Strain-induced pseudo-magnetic field in graphene has received extensive attention in both theoretical and experimental aspects, opening up a new research field named “straintronics” [1]. In previously studies, scanning tuning spectroscopic measurement detected a huge pseudo-magnetic field at strain induced graphene nanobubbles. [2]. This pseudo magnetic field is expected to lead to pseudo-Landau levels and many interesting phenomena such as the quantum valley Hall effect.

Here, we develop a new approach to create corrugation strain in any selected mesoscopic region on graphene and/or other van der Waals materials. This approach is more flexible than uncontrollable deformation such as nanobubble or ripple [3]. We report the observation of an unconventional negative magnetoresistance (MR) in corrugated graphene system when an in-plane magnetic field is applied. Additionally, the negative MR shows anisotropy of current direction and has an unusual dependence with Fermi energy. We argue that this negative MR may be related to berry curvature and helicity imbalance [4,5], which are non-trivial effect in graphene system. This study demonstrates the capability to utilize strain to modify the magnetotransport properties and may pave the way for straintronics in graphene and other van der Waals materials.

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