Unusual zero-energy tunneling properties in shifted bilayer graphene

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ABSTRACT

Two graphene layers generally stack over the common AB or Bernal stacking configuration. Recently, it has been reported that several types of stacking defects can occur in natural and synthetic graphene bilayer systems, such are: rotational or translationnal mismatch between the two layers as compared to the perfect AB stacked bilayer.

It has been reported that stacking defaults affect the band structure and turn each parabolic band crossing of a bilayer into pairs of Dirac cones.

Here we theoretically investigate how a stacking defect occuring in the bilayer graphene could affect zero-energy transport properties.

We show that, surprisingly, a stacking default (for example a twist) in a bilayer can result in a perfect transmission at normal incidence as a result of Fabry-Pérot type resonances at zero-energy , happening only for a specific orientation of the Dirac cones with respect to the incident electron and for quantized values of their separation in reciprocal space [1]. These zero-energy Fabry-Pérot resonances have no direct analog neither at zero-energy Monolayer graphene either Bernal-bilayer graphene. We also predict an other amazing effect occuring for some shift parameters (values of the pairs of Dirac cones separation in reciprocal space) is that a potential barrier on shifted bilayer graphene could act as a cloak for zero-energy confined states which became invisible via transmission. Thus, we predict a new electronic cloaking effect in an undoped shifted bilayer graphene that has no analog either in the undoped MG neither in the undoped Bernal BLG. This cloaking effect, which arises from the chirality of quasiparticles in shifted bilayer graphene, is predicted to be very sensitive to the shift parameter.

Our results provide a way to modulate the electron transmission through such a graphene based device. A controllable transmission, as well as the detection of the perfect and the vanishing transmission, can be realized conveniently by tuning either the stacking structure and/or the incidence angle. The transmission probability through the undoped shifted graphene bilayer can be considered as a fingerprint of the stacking defect.

REFERENCES

[1] Daboussi, A. , Mandhour, L. , Fuchs, J.N., and Jaziri, S. , Phys. Rev. B **89**, 085426 (2014)