QUANTUM TRANSPORT IN STRAINED GRAPHENE BARRIERS

R. Kerjouan[1]
M. Rosticher[1], A. Pierret[1], M.-B. Martin[2], D. Dolfi[2], K. Watanabe[3], T. Taniguchi[3], S. Dhillon[1], B. Plaçais[1], M. Görbig[4] and J. Mangeney[1]
[1] *Laboratoire de Physique de l'Ecole normale supérieure, ENS, Paris, France*
[2] *Thales Research and Technology, Palaiseau, France*
[3] *National Institute for Materials Science, 1-1 Namiki, Tsukuba, 305-0044, Japan*
[4] *Laboratoire de Physique des Solides, CNRS, Université Paris-Sud, Orsay, France.*
romaine.kerjouan@phys.ens.fr

Strain provides a powerful tool to tailor the scalar and vector potentials which Dirac fermions undergo in graphene. This gave rise to new phenomena at the nanoscale such as giant pseudo-magnetic fields and valley polarization [1]. Here, we unveil the effect of deformation on the quantum transport across a barrier of strained graphene. We transfer a high-mobility exfoliated graphene flake covered by a thin hBN layer on a nanostructured hBN substrate. The Top-hBN layer and the graphene conform to the substrate, creating periodic strain-induced barriers for electrons over a length of 10 µm (Fig. 1. a) and b)). Using low-bias transport measurements, we observe the emergence of a broad satellite resistance peak at positive energy, in contrast with unstrained graphene [2] (Fig. 1 c) and d)). We show that this experimental trend is quantitatively described by the reduced transmission probabilities of ballistic electrons through a strain barrier that can be described by low-energy Hamiltonian of graphene modified by a scalar potential and a pseudo-vector potential (Fig 1 e)) [3]. Our results demonstrates that corrugated van der Waals heterostructures is a promising platform for strain engineering with a view to applications and fundamental physics.

References

[1] Hsu, C.-C. *et al.*, Sci. Adv., **6** : eaat9488 (2020)
[2] Huang, P. *et al.*, Nat Commun **11,** 863 (2020)
[3] McRae, A.C. *et al.*, Phys. Rev. Appl. **11**, 054019 (2019)

Figures

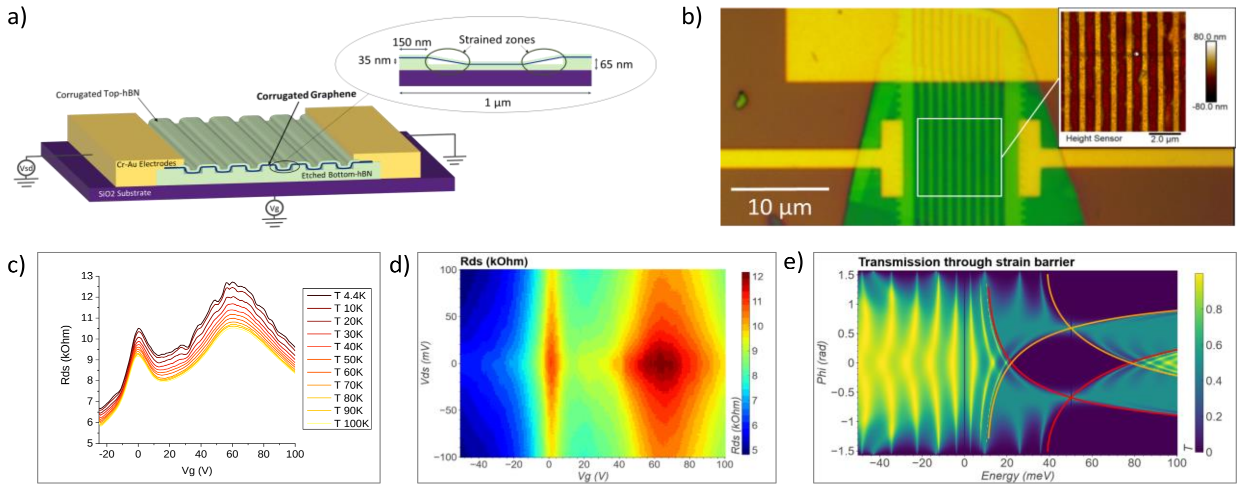

Figure 1: a) – Principle: Schematic view of the corrugated hBN/graphene/hBN device b) – Fabrication: Optical image of an encapsulated corrugated graphene. Inset: an AFM image of the corrugation c) R_{ds} as a function of Vg at zero-biais for different temperatures. d) Map of differential resistance R_{ds} as a function of the gate voltage V_g and of the bias voltage V_{ds} at T = 4.4 K. e) – Theory: Transmission probability through a 150nm long strain barrier with uniaxial strain ε= 2% in the zigzag direction as a function of the electron energy E and the incidence angle on the barrier φ. Red lines correspond to the limits of authorized incident angles for valley K and the orange ones for valley K'