Ideal electrical transport using technology-ready graphene

Camilla Coletti[1, 2, *]
Sergio Pezzini,[1, 2,] Vaidotas Mišeikis,[1, 2] Simona Pace,[1, 2] Francesco Rossella,[3] Kenji Watanabe,[4] Takashi Taniguchi,[4]
[1]*Center for Nanotechnology Innovation @NEST, Istituto Italiano di Tecnologia, Piazza San Silvestro 12, 56127 Pisa, Italy*
[2]*Graphene Labs, Istituto Italiano di Tecnologia, Via Morego 30, 16163 Genova, Italy*
[3]*NEST, Scuola Normale Superiore and Istituto Nanoscienze-CNR, Piazza San Silvestro 12, 56127 Pisa, Italy*
[4]*National Institute for Materials Science, 1-1 Namiki, Tsukuba, 305-0044, Japan*
Camilla.coletti@iit.it

Producing and manipulating graphene on fab-compatible scale, while maintaining its remarkable carrier mobility, is key to finalize its technological application. We show that a large-scale approach (CVD growth on Cu followed by polymer-mediated semi-dry transfer) yields single-layer graphene crystals undistinguishable, in terms of electronic transport, from micro-mechanically exfoliated flakes [1]. hBN is used to encapsulate the graphene crystals – without taking part to their detachment from the growth catalyst – and study their intrinsic properties in field-effect devices. At room temperature, the electron-phonon coupling sets the mobility to ~1.3 × 10^5 cm^2/Vs at ~10^{11} cm^{-2} concentration. At cryogenic temperatures, the mobility (> 6 × 10^5 cm^2/Vs at ~10^{11} cm^{-2}) is limited by the devices' physical edges, and charge fluctuations < 7 × 10^9 cm^{-2} are detected. Under perpendicular magnetic fields, we observe early onset of Landau quantization (B ~ 50 mT) and signatures of electronic correlation, including the fractional quantum Hall effect.

References

[1] Sergio Pezzini, Vaidotas Mišeikis, Simona Pace, Francesco Rossella, Kenji Watanabe, Takashi Taniguchi, Camilla Coletti, https://arxiv.org/abs/2005.02284

This project has received funding from the European Union's Horizon 2020 research and innovation programme Graphene Flagship under grant agreement No 881603