Tunable 2D superlattices in graphene

Robin Huber[1]
Martin Drienovsky[1], Andreas Sandner[1], Ming-Hao Liu[2], Szu-Chao Chen[2], Takashi Taniguchi[3], Kenji Watanabe[3], Dieter Weiss[1], Jonathan Eroms[1]

[1]*University of Regensburg, Universitätsstraße 31, Regensburg, Germany*

[2]*Department of Physics, National Cheng Kung University, Tainan 70101, Taiwan*

[3]*National Institute for Materials Science, 1-1 Namiki, Tsukuba 305-0044, Japan*

robin.huber@ur.de

In order to study the effect of 2D superlattices on graphene, moirés [1] or patterned dielectrics [2] can be used. Here we present an additional method to induce tunable superlattice effects in graphene by the combined action of a global silicon backgate and a patterned bottom gate made from few layer graphene by standard electron beam lithography techniques [3]. By switching on a 2D periodic charge carrier density modulation additional Dirac peaks can be observed which are the source of additional Landau fans in magnetotransport. Due to the interplay between the lateral 2D superlattice and a magnetic field, features of the "Hofstadter butterfly" energy spectrum can be resolved. We show low temperature transport measurements on a 2D superlattice in graphene with square lattice symmetry and a lattice period of 40 nm. In addition we show magnetotransport data at an elevated temperature of 120 K where Landau quantization vanishes but Brown-Zak oscillations, which are caused by the 2D periodic potential, are still visible comparable to experimental results on moiré superlattices [4].

References

[1] C. Dean *et al.*, Nature, **497** (2013) 598
[2] C. Forsythe et al., Nature Nanotech., **13** (2018) 566
[3] M. Drienovsky *et al.*, Physical Review Letters, **121** (2018) 026806
[4] R. Krishna Kumar *et al.*, Science, **357** (2017) 181

Figures

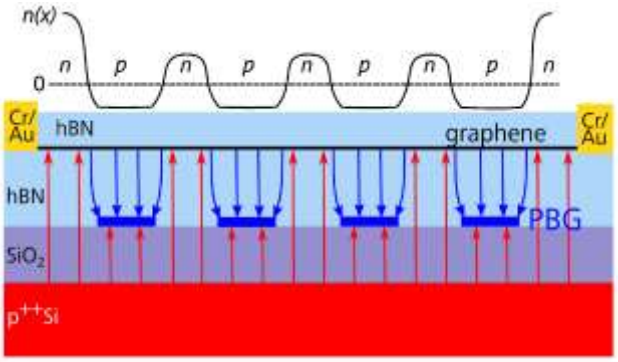

Figure 1: Sample design to induce a 2D perodic charge carrier density modulation in graphene by the combined action of a global silicon backgate and a patterned bottom gate (PBG)

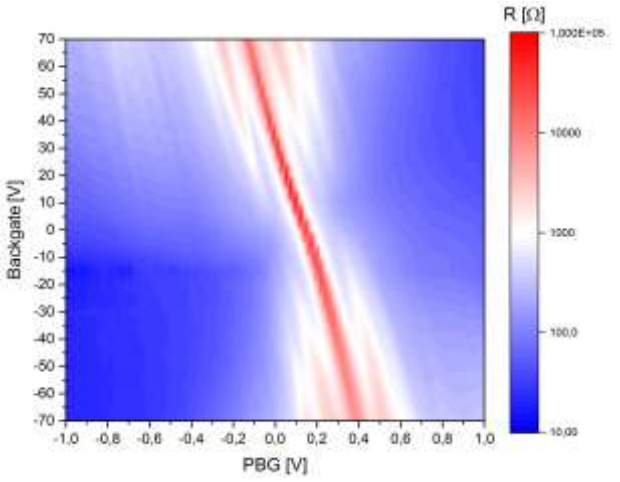

Figure 2: Appearance of satellite peaks besides the main Dirac peak by switching on a 2D periodic potential with backgate voltage