Tuning ultra-clean band gaps in bilayer graphene heterostructures

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Bilayer graphene (BLG) allows the opening of a tunable band gap by applying a perpendicular electric displacement field. First indications of a tunable band gap were obtained more than 10 years ago [1]. The early devices were based on a global silicon back gate, but it was not possible to completely pinch-off the current: The maximum resistances ranged from hundreds of Kilo Ohms to several Mega Ohms [2.3]. Recently, this limitation has been overcome by the use of local graphite back gates. The resistance of such devices reached tens of Giga Ohms [4], which enables high quality mesoscopic devices based on electrostatic confinement. The reason for this is not yet fully understood. We present here a detailed study of the difference between local and global gating strategies. For three different sample designs (global doped silicon gate, local Au gate and local graphite gate) we use a combination of finite bias and temperature activated transport measurements and electrostatic simulations to distinguish between different types of lateral potential variations in the samples that limit the maximum resistance. For graphite gates we find a maximum resistance in the order of 10 Giga Ohm and a gap up to 60 meV for large displacement fields (see Fig. 1).

References

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Figures

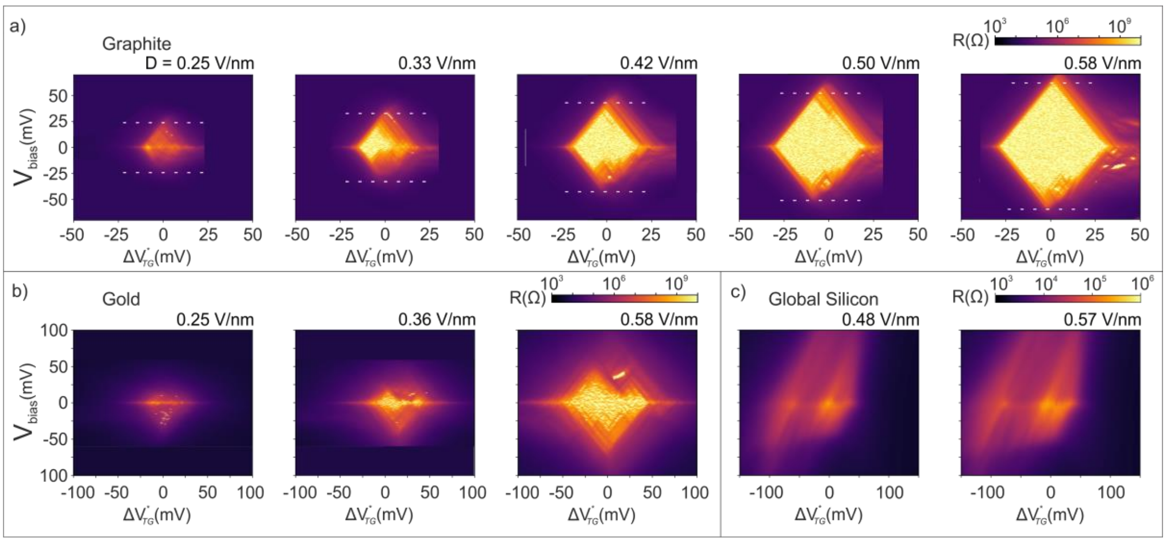

Figure 1: Resistance *R* in gapped bilayer graphene at different displacement fields *D* as function of bias voltage V_{bias} and top gate voltage relative to the charge neutrality point. The back gate voltage is chosen such that the displacement field stays constant. The diamond-shaped increase of the resistance highlights the well-developed band gap in the BLG.