Comparative study of nano-scale and macro-scale field-effect mobility in CVD graphene

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Abstract
As commercial applications of graphene based technologies start emerging, accurate and rapid electrical characterization of large-area CVD graphene is becoming increasingly important for monitoring graphene growth/transfer uniformity and reproducibility [1]. Terahertz spectroscopy has been touted as an excellent non-contact method for electrical characterization of graphene, making it useful for a range of commercial applications where it is important to identify the sheet conductance [2] and field-effect mobility [3]. THz spectroscopy probes these parameters on the scale of tens to hundreds of nanometres [2] whereas the conventional macroscopic van der Pauw technique probes the same parameters on much larger scale, e.g. 1 mm. In this study we evaluate the difference in field-effect mobility extracted with these two methods. We present measurements of large-area CVD graphene and are able to make direct comparisons between gated broadband THz measurements with gated van der Pauw measurements on the same devices. With concurrent Hall effect measurements this allows us to determine the carrier concentration independently from the typical capacitance/mobility calculation. This enables a systematic comparison between the nano-scale and macro-scale field-effect mobilities as well as the macro-scale Hall mobility due to our calibrated carrier concentration.

References
[1] A. Zurutuza et. al., Nature nanotechnology, **9(10)**, 730-734. (2014).
[2] J.D. Buron, et al., Nano Lett. **12**, 5074 (2012).
[3] J.D. Buron, et al., Sci. Rep. in review.

Figures

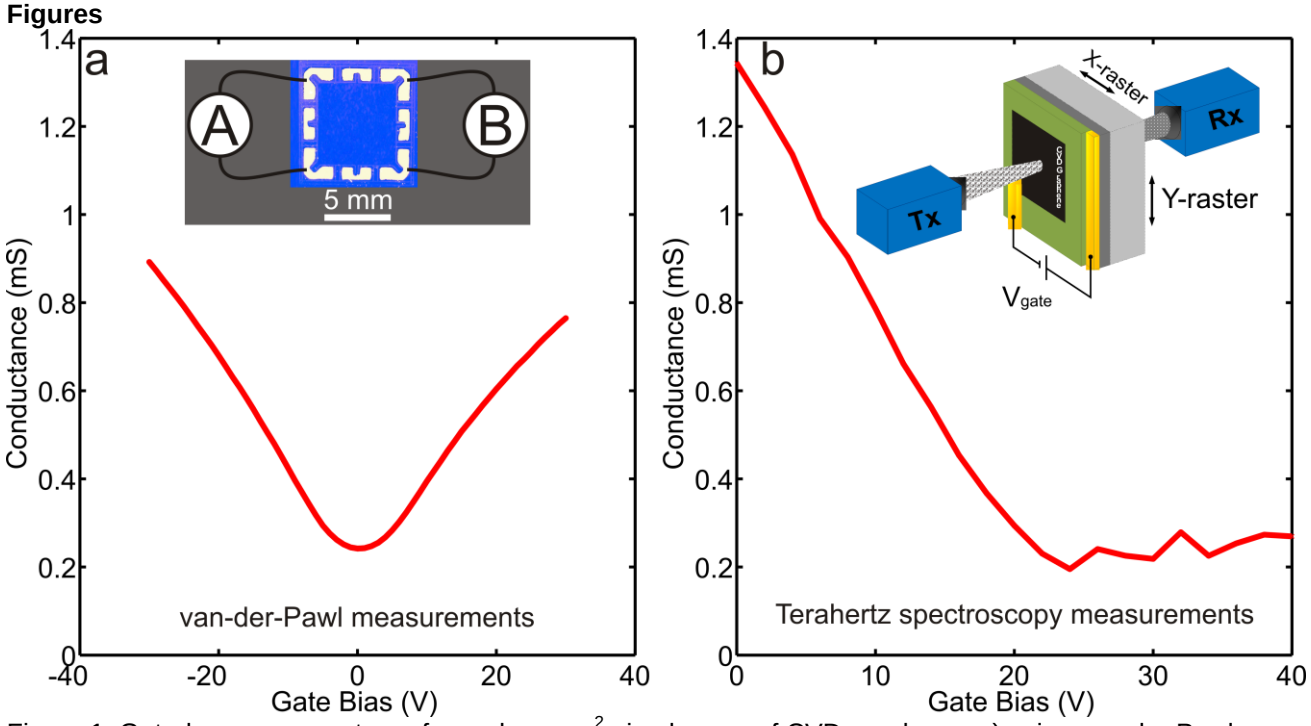

Figure 1: Gated measurements performed on mm^2-sized areas of CVD graphene: a) using van der Pawl measurement technique with fixed gold electrodes. Inset: typical device with example of vdP circuit. b) using broadband transmission THz spectroscopy. Inset: schematic of terahertz setup showing gated measurements of graphene.