Electrical Resistance Tomography as a characterization tool for large-area graphene

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Electrical Resistance Tomography (ERT) is a non-scanning imaging technique that retrieves maps of the electrical conductivity of an object, from electrical measurements performed at its boundary. From the mathematical point of view ERT is an ill-posed, inverse Laplace problem [1]. ERT is a variant of Electrical Impedance Tomography, which was principally developed for clinical applications as a high-contrast qualitative imaging technique of tissues [2]. The authors have recently applied, with encouraging quantitative results, the ERT technique to conductive metal-oxide thin film samples [3], and are currently extending the application to graphene samples.

Fig. 1 shows the schematic diagram of the ERT implementation. Four-terminal resistance measurements are performed on 16 electrical contacts in mechanical touch with the sample. The measurements are performed with a dc current source, a voltmeter, and a relay-switching unit. The switching unit (4×16 channels, only a few shown in Fig. 1) allows performing the transresistance measurements by following different stimulation/measurement patterns [4]. Software performs the reconstruction by solving the ERT inverse problem by finite-element method and optimized regularization. The outcome is a reconstruction of the sample conductivity map.

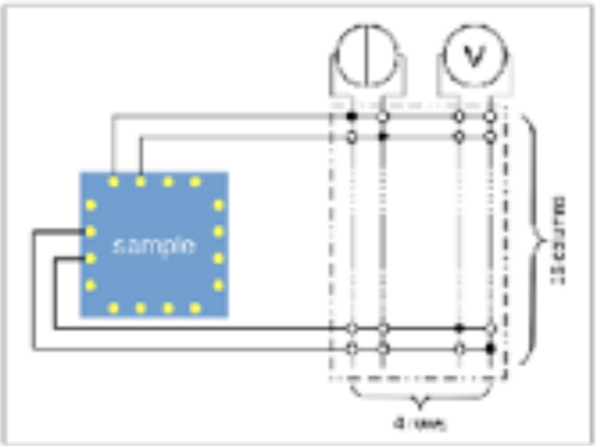

Fig. 1 ERT measurement setup schematic. The black/withe dots represent closed/open connections of the swithcing system.

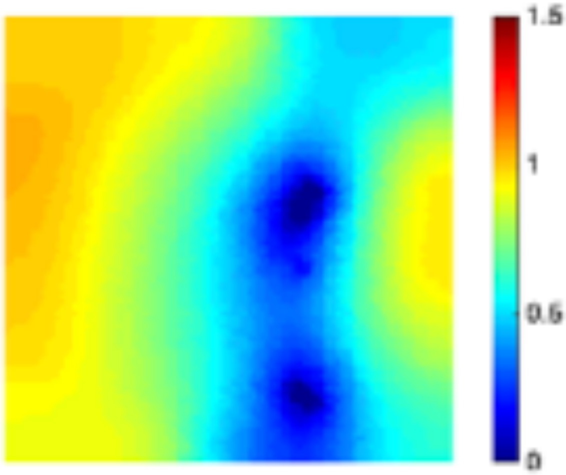

Fig. 2 ERT map of a CVD graphene sample. Colors represent the elctrical conductivity in mS.

ERT can be a fast and effective technique to assess the uniformity of large-area graphene samples. An example of ERT measurement is given in Fig. 2, performed on 1×1 cm^2 sample of commercial chemical-vapor deposited graphene on silicon/silicon dioxide wafer. In Fig. 2, the presence of a lower conductivity region (likely due to a defect) can be observed. The overall sample conductivity is in the mS range, typical of this type of graphene samples. A review of other ERT measurement outcomes, including some recent measurements with back-gate polarisation of the sample, will be reported at the Conference.

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