Hall measurements and low frequency noise characterization of inkjet-printed graphene

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Abstract

Inkjet-printing of exfoliated 2D materials has recently emerged as a very promising approach for the development of low-cost electronics on any arbitrary substrate [1, 2]. A complete electrical characterization of printed layers is however lacking, due to the novelty of this topic.
To this purpose, here we report room temperature Hall measurements of inkjet-printed graphene films in order to evaluate charge mobility as well as intrinsic doping of the printed layers [see Fig. 1 (a)]. Current-induced heating in vacuum is employed to remove solvents from the ink, improving the electrical conductivity. Most importantly, current annealing is found to enable Hall bar analysis in a consistent and reproducible way, by suppressing large fluctuations and a significant drift in the measured Hall voltage (V_H) [see Fig1 (b)]. The carrier density (n) and mobility (μ) of the printed layers are shown in Fig. 2. We also address the low frequency noise, which provides relevant information regarding the transport mechanisms at play. As can be seen in Fig. 3, the measured noise shows a $1/f$ dependence. From the empirical formula: $S_V(f)/V^2=\alpha_H/fN$, where V is the applied voltage, $S_V(f)$ its power spectral density, f the frequency, N the total number of carriers in the device, we obtain a Hooge parameter $\alpha_H = 3.2\text{x}10^{-2}$. This value is comparable with the ones previously observed for CVD-grown graphene films [3].

References

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Figures

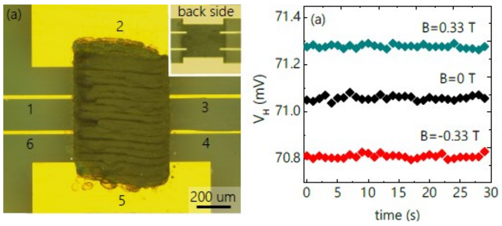

Figure 1: (a) Representative optical microscope micrograph of a graphene Hall bar on glass. (b) V_H as a function of time for positive, negative and zero applied magnetic field.

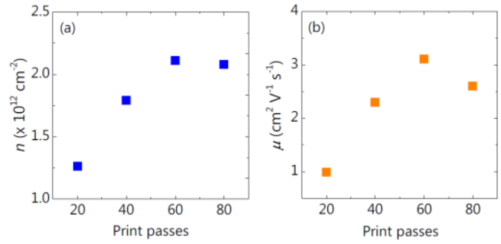

Figure 2: (a) n and (b) μ of the printed layers as a function of the number of print passes.

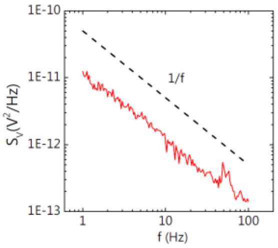

Figure 3: S_V as a function of f for a inkjet-printed graphene device realized with 80 print passes.