Low-Frequency Noise Mitigation in Graphene Field-Effect Transistors by Contact Resistance Engineering

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Low-frequency noise (LFN) and contact resistance (Rc) appear as two major limiting factors for the application of graphene field-effect transistors. In this work, Rc and LFN are measured in wafer-scale arrays of graphene solution-gated field-effect transistors (G-SGFETs) with different contact designs and channel geometries. The variation of the graphene-metal overlap length (Lc) (Fig. 1) allows to determine the dominant charge transfer path at the graphene-metal interface. Injection through the graphene edges is found dominant, implying that Rc is inversely proportional to the density of carriers in graphene at the contacts. The measurement of LFN in the same devices allows determining the correlations between the density of carriers and low-frequency noise generated at the contacts. Their relationship can be described by a noise model based on charge trapping-detrapping processes[1], suggesting that this phenomenon could originate contact noise. The LFN generated at the contacts and at the channel are shown to be measurable independently of each other by adjusting the geometrical and gate bias conditions. Finally, a model describing the geometrical dependence of both contributions to noise is derived and used to define a set of device design rules to minimize the impact of contact noise and achieve an optimized signal-to-noise ratio. Our results present edge contacts[4] as a promising approach to reduce simultaneously contact resistance and noise in graphene FETs (Fig. 2).

References

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Figures

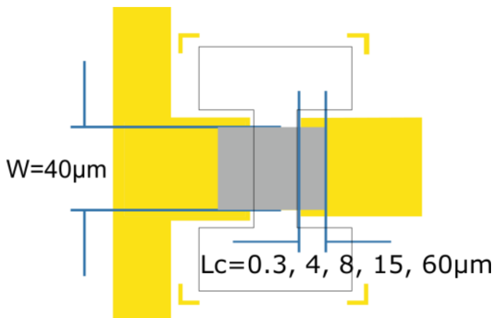

Figure 1: G-SGFET with the parameter graphene-metal overlap length (L_c) defined.

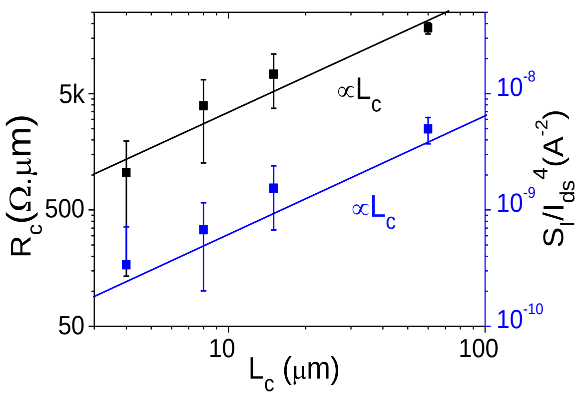

Figure 2: Scaling of R_c and normalized current noise with the length of graphene-metal overlap at the contacts.