Origin of 1/f noise in Graphene Field Effect Transistors with Liquid Gate

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The interest of noise response in graphene transistors with liquid gate is two-fold: on one hand it serves as a signature related to the material quality and on the other hand it can directly provide an estimation of the minimum signal-to-noise ratio for biochemical sensing. In this work, the drain current 1/f noise of liquid gated field effect transistors (FETs) with graphene channel [1,2] is experimentally studied. The noise level variation observed when applying a liquid gate voltage bias (through deionised water) enabled the experimental data to be successfully fitted (Figure 2) using the carrier number fluctuations model, which includes trap-related correlated mobility fluctuations (CNF/CMF) [3]. This model considers that the 1/f noise originates from the trapping/de-trapping of carriers in slow interface/oxide traps, thus resulting in carrier mobility fluctuations due to their proximity to the fluctuating trapped charge. In contrast, the Hooge model (pure mobility fluctuations) could not explain the measured data trends. This suggests that the dominant noise source in the studied GFETs stems from charge traps at the oxide interfaces rather than from graphene lattice scattering.

References

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Figures

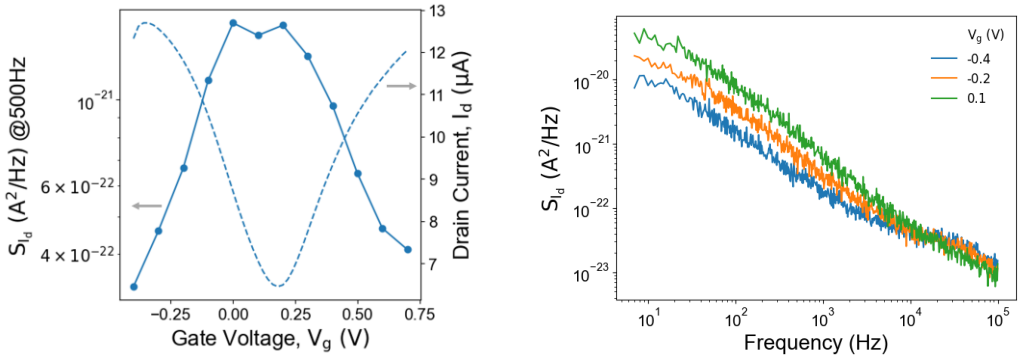

Figure 1: Left: Measured drain current and extracted power spectral density at 500 Hz versus gate voltage. Right: Measured PSD spectra for three gate voltage bias.

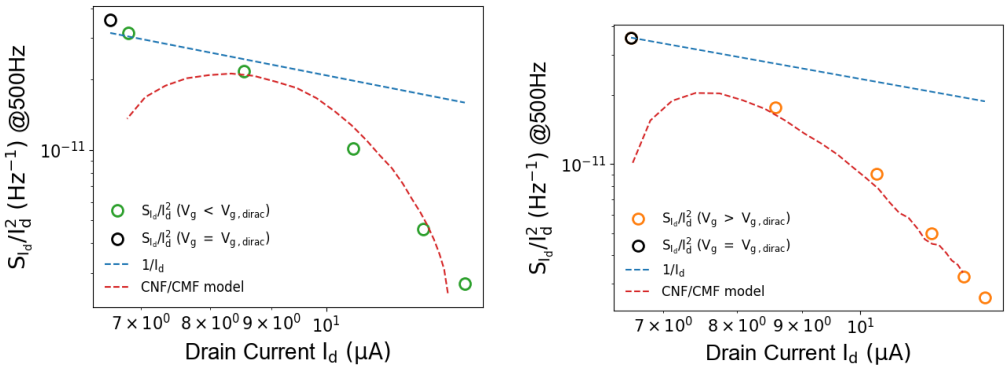

Figure 2: Normalized drain current PSD with Hooge (~1/I_d) and CNF/CMF model fits versus drain current extracted at the Dirac point (black dot) and in the hole (left, green dots) and electron regimes (right, orange dots).