Low frequency noise modelling in single-layer graphene FETs

Nikolaos Mavredakis[1], Ramón García Cortadella[2], Andrea Bonaccini Calia[2], Jose A. Garrido[2], David Jiménez[1]

[1]*Department d'Enginyeria Electrònica, Escola d'Enginyeria, Universitat Autònoma de Barcelona, 08193-Bellaterra, Barcelona, Spain.*
[2]*Catalan Institute of Nanoscience and Nanotechnology (ICN2), CSIC, Barcelona Institute of Science and Technology, Campus UAB, Bellaterra, Barcelona, Spain.*

nikolaos.mavredakis@uab.cat

In this work, a new analytical model is proposed for low frequency noise (LFN) in single layer graphene FETs (GFETs). The model is derived based on a methodology proposed for Metal Oxide Semiconductor FETs (MOSFETs) where the device channel is divided into elementary sections[1]. It is then implemented considering the chemical potential-based compact model of Ref. 2. LFN fluctuations at each local section are modeled by a local current noise source as shown in Fig. 1. Data from liquid-gated GFETs[3] accurately validate the proposed model at different device dimensions and operating conditions. Carrier number (ΔN) and mobility fluctuations (Δμ) effects are the main phenomena that generate LFN in electron devices. We demonstrate that both contribute to the bias dependence of LFN in GFETs especially near the Dirac point, where the well-known M-shape[4] is also observed in our data. Fig. 2 illustrates that the residual charge r0 is responsible for the M-shape when ΔN fluctuations dominate. The higher the residual charge, the more intense the M-shape predicted by the ΔN model. The Δμ model, however, follows a Λ-shape and its contribution can be significant near the Dirac point. A slight increase of the minimum of LFN at Dirac point when V_{DS} increases is caused by the graphene charge inhomogeneity, which is taken into account by the model.

References

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Figures

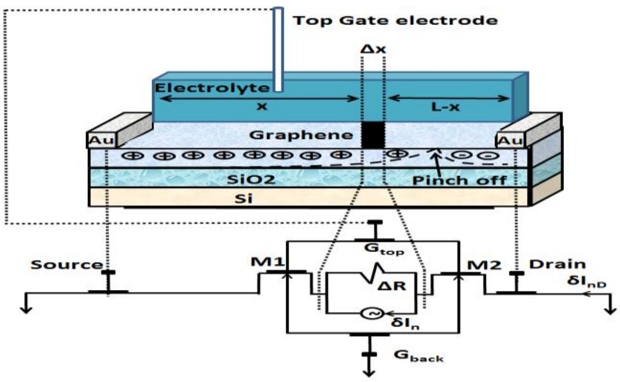

Figure 1: Device cross section with the equivalent circuit of a local current noise contribution to the total noise[1].

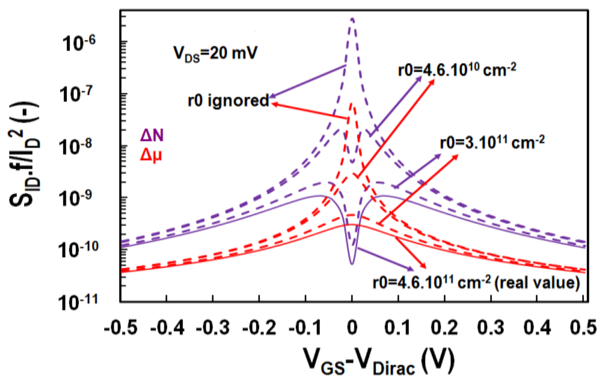

Figure 2: *ΔN* and *Δμ* effects at $V_{DS} = 20\ mV$ for four different values of residual charge (*r0*).

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