1/f noise characterization of graphene-based neural sensors

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Graphene based solution-gated field-effect transistors (SGFETs) hold great promise for biosensors and bioelectronic applications. Due to its unique combination of electronic, mechanical, and chemical properties, such as high charge carrier mobility, flexibility and good biocompatibility, graphene has been shown to be an excellent material for sensing in electrolyte environments.

Sensors based on graphene SGFETs have already been developed on rigid and flexible substrates for various analytes, as well as for the detection of single cell signals.[1] However, this technology still needs some improvement in terms of electronic noise. Low frequency 1/f noise in graphene limits the performance of the device in sensing applications as well as for scalable radio-frequency (RF) applications. [2]In this contribution we present a detailed study of the low frequency 1/f noise of flexible graphene solution-gated field-effect transistors and compare their performance to graphene SGFETs on rigid substrates.

We show that the Hooge's empirical formula fails to describe the gate dependence of the noise and that a charge-noise model suggested by Heller et al. fits better the data. [3] This work discusses the correlation of the transistor noise with the device transconductance, the active area, the substrate onto which the transistor are farbicated and the electrolytic environment. Finally, the flexible technology is tested in *in vivo* experiments on rats in which the epicortical neural activity (local field potentials) is successfully detected and compared to conventional technology.

References

[1] Hess et al., Advanced Materials (2011) 43, 5045–5049

[2] Heather et al., Appl. Phys. Lett (2016) 108, 073108

[3] Heller et al., Nano Lett. (2010) 10, 1563-1567

Figures

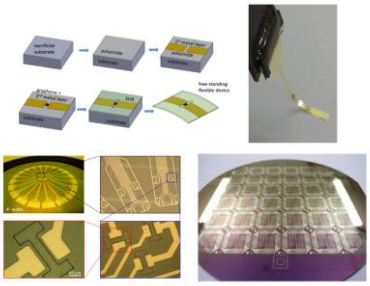

Figure 1: Fabrication steps and finalized graphene SGFETs on flexible and rigid substrates.

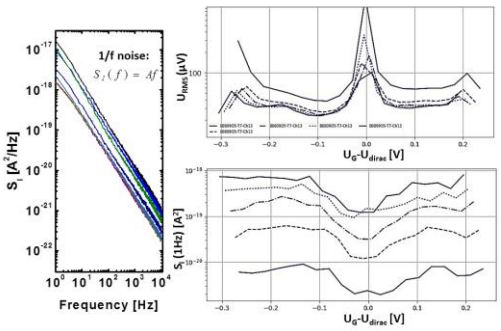

Figure 2: 1/f noise characterisation of the fabricated graphene sensors.