Graphene transistors for ultra-slow frequency (< 0.1Hz) *in vivo* neural recordings

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Ultra-slow potential changes (<0.1Hz) play a significant role in brain pathophysiology [1, 2]. Nonetheless, recording at such low frequencies with high-spatial resolution is challenging due to: i) voltage drift that can result in amplifier saturation and ii) high electrode impedance causing signal distortion [3, 4]. For these reasons, ultra-slow frequencies are systematically filtered out from microelectrode neural recordings by default, which leads to situations in which physiological and pathological meaningful features are ignored. We report on the capabilities of solution-gated graphene field-effect transistors (SGFETs) to record ultra-slow frequency signals (<0.1Hz) alongside signals in the typical local field potential bandwidth (0.1-500Hz) [5]. We attribute the obtained results to the direct field-effect coupling, and the excellent electrochemical stability of graphene. Using microfabricated flexible epicortical arrays of 16 SGFETs, we validated graphene capabilities *in vivo* by mapping KCl-induced cortical spreading depression in Wistar rats. Considering these unique recording capabilities, we consider graphene SGFETs a promising technology for recording ultra-slow frequencies with high-spatial resolution.

References

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Figures

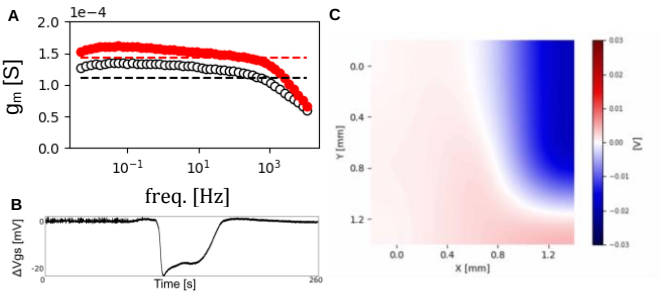

Figure 1: A) Transconductance (g_m) frequency response of a 100x50-µm² graphene transistor measured in 10 mM phosphate buffer saline. Dots correspond to values obtained at two different gate-source voltage polarizations: more negative (red) or positive (black) with respect to the charge-neutrality point. Dashed lines represent the corresponding steady-state transconductance value. B) Equivalent gate-source voltage variations recorded during the occurrence of a KCl-induced spreading depression in rat cortex. C) Voltage map at the time when a spreading depression wave is crossing an epicortical probe consisting of a 4x4 graphene transistor array.