Neural interfaces based on flexible graphene transistors

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Abstract

The brain activity spans over multiple temporal and spatial scales that requires a set of technologies to advance in its understanding. The advance in neuroscience has benefited from coordinated and interdisciplinary efforts from different fields such us genetics, electrophysiology, or computational tools. Electrophysiology is consistently used to measure the brain activity due to the electrical nature of neuronal activity, and requires of an efficient transducer to record the voltage drop caused by ionic transmembrane currents in the brain tissue. Passive metallic electrodes are the most commonly used transducers. Alternatively, thanks to their unique set of properties, graphene enables the implementation of the so-called graphene based solution-gated field-effect transistor (gSGFET) as novel transducer for neural signals [1]. The use of gSGFET is able to overcome the limitations of passive electrodes in DC coupled operation, enabling the recording of infra-slow activity (ISA). The ISA signatures may serve as diagnostic, prognostic, and treatment monitoring tools for some neurological and psychological disorders [2]. The use of a transistor as a transducer also enables the implementation of multiplexing strategies by addressing arrays arranged in rows and columns. This fact allows to reduce the connectivity and scale up in number recording sites.

References

[1] Hébert, C., et al.: Advanced Functional Materials. 28 (12), 1703976 (2018)
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Figures

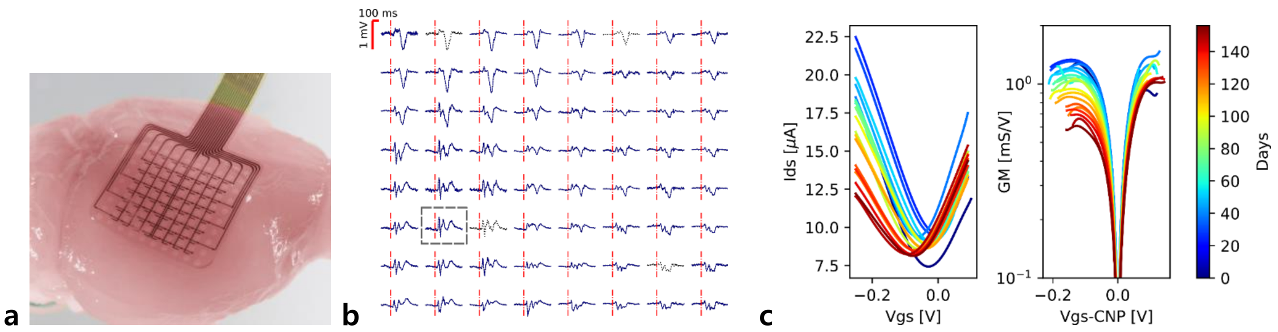

Figure 1: a) Image of 8x8 (64 gSGFETs) multiplexed neural interface. b) Mapping of visual evoked response recorded by 8x8 multiplexed probe. c) Evolution of the electrical characteristics of an implanted neural interface. Lines represent the mean value of all transistors in the array and colors indicate implanted days.