Flexible solution-gated graphene field-effect transistor arrays for in vivo recording of neural signals

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Brain-computer interfaces and neural prostheses based on the detection of low frequency neural signal are a rapidly growing research and commercial field expected to bring new hope for patients suffering from neural disorders or loss of motor functions. Several technologies are currently competing to be the first reaching the market; however, none of them fulfil all the requirements of an ideal interface with nerve tissue neurons. Thanks to its biocompatibility, low dimensionality, mechanical flexibility and electronic properties, graphene is one of the most promising material candidates for neural interfacing.

In this contribution, we will demonstrate the integration of arrays of solution-gated graphene field-effect transistors onto flexible polyimide neural implants. The devices were placed at the surface and inside the visual and auditory cortex of rats in order to record the activity of the neural network under light and sound stimulation during acute experiments. Similarly, by placing the implants on the cornea of rats, we were able to record the induced activity of the retina under light stimulation. Before each recording, the transistors were fully characterized in-vivo using custom-designed electronics to assess their functionalities. Hence, by varying the location in the brain and the type of neural recording, we prove that our graphene-based technology offers very good performance, in particular high flexibility and good signal-to-noise ratio, for the detection of low frequency neural signals.

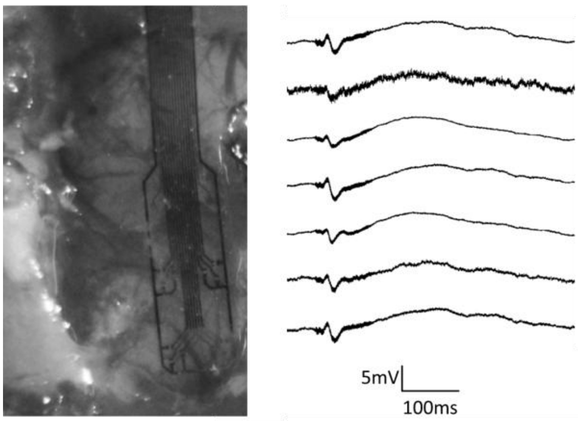

Figure 1: Solution-gated graphene field-effect transistor array placed on the auditory cortex of a rat and the associated auditory evoked potentials recorded using the same device