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Institut d'Electronique, de Microélectronique et de Nanotechnologie
UMR CNRS 8520

Master and Engineer Internship: 2021-2022

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Title : Graphene oxide flakes deposition on 3D neural interface

Abstract :

Recently, graphene has drawn tremendous attention in neuroscience research owing to its flexibility, transparency, high conductivity, low noise, and biocompatibility. This two-dimensional single-atom thick material has already shown to be promising for various neurotechnology applications including multimodal interfaces and closed-loop systems. To-date, graphene and its relatives has been used either passively in various microelectrode array configurations or actively in transistors. The primary signals detected and recorded by graphene neural interfaces are categorized as electrical, such as local field potentials, and chemical, such as neurotransmitter concentration. In this internship, we'll mainly focus on the GO (graphene oxide) flakes deposition on either planar or 3D network of electrodes for neurons interfacing in an ultimate integrated MEA device. Electrode network devices will be fabricated by the "Materials and Processes for nanoelectronics" group (Dr. Guilhem Larrieu, DR CNRS) @LAAS institute in Toulouse. For electrode functionalization, 2 main strategies will be considered. The first one will consist in electrode surface functionalization to promote electrostatic interaction with the negatively charged GO flakes. The second approach will use the electrophoretic deposition mean (EPD) to deposit GO flakes onto electrodes. Post-treatments as annealing could also be considered if needed. The deposition methods will be first assessed on planar electrode configuration *via* SEM, AFM, raman, XPS and electrical characterizations. Once validated, the chosen method will be used for the GO flakes deposition on 3D neural network of electrodes and fully characterized as for planar electrodes. In the meantime, cytotoxicity of the newly synthesized interfaces will be evaluated for primary cortical neurons by checking metabolic activity and cell death. Finally, neurons growth will be achieved on the integrated interface and registration of electrical signals or stimulation will be performed under specific *in vitro* conditions. This new neuronal interface will help us and the neuroscience community to find additional tools to evaluated the efficacy of drug treatment in the frame of dementia such as Alzheimer disease.

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