Development of an organic functionalization layer on Silicon Carbide based neuronal electrode probe in view of *in vivo* implantation.

Description:

Context and objective: The *in vivo* implantation of neuronal electrode probe in the brain is an invasive action which is important in the field of Brain Machine Interface (BMI). It allows to better understand the origin of neuronal disorder pathologies and to remedy them. It requires the realization of neuronal probe exhibiting a high stability as a function of time which is highly challenging. Indeed the implantation of such probe in the brain is accompanied by a progressive loss of electrical neuronal signal. This signal loss is due to the formation of an astrocyte glial cell scar around the probe as a function of time. One of the roles of this scar is to protect the neurons from the foreign object. The longevity of the neuronal probe has to be assured using probe materials which are chemically inert and biocompatible. Moreover this longevity can be increased by covering probe by an organic functionalization layer, the aim of which is to reduce the formation of this glial scar.

Our group is currently developing new neuronal electrode based on full Silicon Carbide (SiC) in the frame of an ANR project called "SiCNeural" (2021-2025). This is based on the exceptional properties of SiC. This a high band gap semiconductor exhibiting several crystalline phases as well as chemical inertness and biocompatibility.

In this context, the internship will focus on the development and optimization of an appropriate organic functionalization layer on the surface of the SiC electrode probe. More particularly, two possibilities can be explored: (i) the deposition/adsorption of hydrogel and (ii) the covalent grafting of organic silane as self assembled molecules. In the first case, hydrogels are interesting as natural organic compound found in human body like hyaluronic acid. In the second case, the silane molecules can be functionalized by various proteins involved in the neuron living.

According to the selected case, the deposition way of the organic layer will be carefully studied. This will be performed by studying its characteristics: thickness, homogeneity, morphology, Young modulus, chemical composition, adhesion, and electrical characteristics. This will be performed using various surface analysis techniques (optical interferometry, AFM, water contact angle, SEM, cyclic voltammetry). Then the time stability will be performed by dipping the samples in buffers mimicking the brain medium. The final aim will be to develop an organic functionalization layer exhibiting optimized characteristics in term of adhesion and time stability for the future *in vivo* implantation.

The M2 internship has a fixed duration of 6 months, starting in February 2022.

Research profile & skills (required / highly desirable): surface chemistry, thin film characterization, neuroscience, biology, soft material films

Scientific environment:

The candidate will work within the LMGP, Materials and Physical Engineering Laboratory. Located in the heart of an exceptional scientific environment, the LMGP offers the applicant a rewarding place to work. Also the candidate will work at LM IMEP-LaHC and INSERM partner of the ANR project.

LMGP Web Site: http://www.lmgp.grenoble-inp.fr/

Salary: Pay scale of a fixed term post as a CNRS/G INP Researcher (depending on the candidate's experience)

M2 : 550 €/month)

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