NÉEL INSTITUTE Grenoble

Topic for M2, PhD and Post-doctoral fellow

High-density graphene transistors (GFET) for sensing of neuron networks

General Scope: Tracking activity on long time-scales in biological neural networks remains a major challenge for the development of multiple practical applications. For example, activity evolution over time can be the signature of learning and can be used for understanding the origin of complex behaviors in living species; modification of activity on long time-scale can originate from long-term degenerative diseases that need to be better understood; development of long-term neural implants for disabled patients require tracking brain activity of very long time-scales. It is thus of first interest to develop a specific methodology that will enable to track evolution of activity in biological neural networks on multiple spatial and temporal scales. Nowadays, only calcium imaging and dense extracellular recordings can simultaneously record activity from hundreds of neurons but remains limited in temporal resolution or invasiveness respectively.

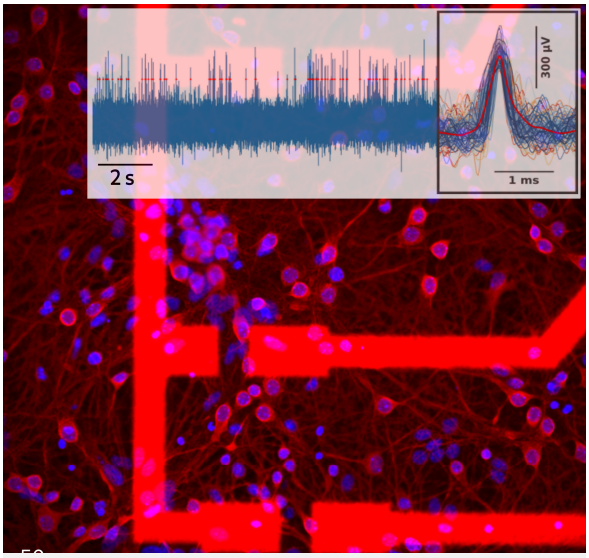

Figure: neurons cultured on-chip above GFET array and single spike recording with GFET (inset)

Research topic and facilities available: In the present job offer, at the interface between nano and neurosciences, we will develop a new generation of bioelectronic imager based on high-density array of transparent field effect transistors (GFET) for tracking in-vitro activity evolution in neural networks. The candidate will develop the complete chain, from device fabrication, electrical measurements in vitro (ie cell culture conditions), surface functionalization for specific detection applications, allowing for a complete comprehension of physical phenomena involved and the optimization for the sensor.

Possible collaboration and networking: The candidate will benefit from the complementary expertise and know-how acquired between the two supervisors in nanodevices and nano-neuro electronics (C. Delacour, Neel Institut, Grenoble), in biochemistry and in neuromorphic/electrical engineering (Y. Coffinier, IEMN Lille), in collaboration with experts in the field of spike sorting algorithms and analysis of extracellular recordings (P. Yger, LilNCog, Lille) and neuromorphic computing (S. Wood, F. Alibart, LN2 Sherbrook).

Required skills: The candidate must have a solid knowledge of physics of semiconductors and devices. Clean-room fabrication, electronics of measurement systems, notion of chemical physics, surface physics or electrochemistry would be appreciated to better understand the interaction at the interface with the top gate liquids. The candidate is expected to enjoy experimental work and the development of adapted measurement protocols. Scientific curiosity, motivation, creativity, tenacity are mandatory qualities in order to take full advantage of the scientific environment of this thesis and to gain excellent expertise for his/her future career. The topic is in the field of applied physics, but close to the fundamental physics, as well as to the industrial world. After the PhD, the candidate will easily adapt to both academic and industrial research environments.

The candidate must have a very good academic record, with high grades.
For the application, send your CV, motivation letter, track of records for your masters (or PhD) and recommendation letter(s).

Contact: Delacour Cécile, Institut Néel – CNRS, cecile.delacour@neel.cnrs.fr ;
Yannick Coffinier, IEMN, yannick.coffinier@univ-lille.fr