It is just a matter of surfaces: how carbon-based multidimensional nanocues can modulate neuronal network activity

Denis SCAINI - *Ikerbasque, Spain*

In the past decade, (nano)technology applications to the central nervous system (CNS) have often involved studying and using novel materials to modulate neuronal activity. The ability to govern neuronal excitability could have a significant impact not only on fundamental neurophysiology but also on developing therapeutic approaches to treat neurological diseases. In this regard, surface (nano)modification via carbon-based nanomaterials (CBNs) was demonstrated to have a pivotal role in neuromodulation. In particular, it has been shown that surfaces functionalised with carbon nanotubes or graphene are fully biocompatible and, remarkably, can induce increased network synaptic activity in interfaced neurons.

In this regard, we discovered that the neuronal network modulated could be reconducted to the synergic contribution of the nanomorphology, chemical activity, and local mechanical properties conferred by carbon nanomaterials to the surface interfacing the neuronal cells. This multimodal surface modification could be used to recapitulate the different cues the extra-cellular matrix (ECM) provides to neurons within the central nervous system. By growing neuronal cells and tissues on 2D supports and measuring the electrical activity by extra/intracellular electrodes, we demonstrated not only that neuronal activity can be modulated by exploiting different surface modifications, but also the possibility of inducing electrical reconnection in lesioned portions of the CNS.