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" Engineering cultured neuronal networks with nanomaterials: carbon nanotubes and neuronal signaling"

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Nanotechnology deals with materials and devices at the nanometer scale and has provided us with the ability to chemically control self-organizing substrates, producing materials with properties that result in an extraordinary degree of functional integration with cellular and physiological systems. Micro- and nanoscale techniques employed to recreate interactions between the cells and the tissue-engineering scaffolds offer great promise in the fabrication of biological tissue constructs. Owing to lack of effective self-repair mechanisms in the adult, central nervous system (CNS) damage results in functional deficits that are often irreversible. Tissue engineering, which aims at rebuilding lesioned CNS circuits, has increasingly involved nanotechnology for the development of super-molecular architectures to sustain and promote neural regeneration following injury. The interaction between neurons and nano-structured materials is increasingly attracting interest, because it holds the potential of unexpected openings towards novel concepts for the design of smart devices based on nano(bio)materials properties. Ongoing efforts in this arena require the development of synthetic extracellular scaffolds able to provide unique microenvironments to tissue-specific cell types.
We used a multidisciplinary approach to investigate the impact of interfacing synthetic nano-materials to neuronal networks. Carbon nanotubes have been at the forefront of nanotechnology due to their unique electrical, mechanical and thermal features, which allow the development of a variety of miniaturized devices with remarkable properties. More recently carbon nanotubes have attracted tremendous attention for the development of nano-bio hybrid systems able to govern cell-specific behaviors in cultured neuronal networks The ability of carbon nanotubes to interact with neuronal signaling holds the potential of providing insights into the functioning of normal physiological mechanisms, that are involved in the modulation of core synaptic properties.