Carbon-based nanotools interfacing with neurons: novel frontiers in nanomaterial-tissue interactions

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Modern neuroscience increasingly relies on material science tools to engineer neuronal network models *in-vitro*. The synergy between engineering and technology with biology can lead to the development of materials and devices for the treatment and monitoring of pathological conditions as well as novel therapeutic strategies. In this framework, carbon-based materials, such as carbon nanotubes (CNTs) and graphene (GR), deserve particular attention, featuring dimensions and properties similar to neural machinery compartments; moreover, they have already been shown to govern *in-vitro* synapse formation, cell excitability, and synaptic processing [1,2]. These materials, composed by pure carbon with different hybridization or structures, possess excellent mechanical strength, electrical and thermal conductivity, and optical properties. Here we describe the development of carbon-based materials able to sustain neuronal survival and to promote neuronal process outgrowth. Moreover, their ability to boost the growth and activity of neuronal tissues, in 2D and 3D neuronal network models [3,4]. The precise biophysical mechanisms of these special interactions are not completely understood, but the features and the remarkable applications of such materials, together with their ability to manipulate neural activity, still hold strong promises in manufacturing interfaces enriched by artificial cues that can improve neuronal performance and guide tissue reconstruction.