Graphene oxide nanosheets reshape synaptic function in cultured brain networks

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Graphene is a highly advanced metamaterial at the forefront of revolutionary applications in neurological diseases. Biomedical developments in general, and in neurology in particular, are focusing on few-layer graphene sheets to manufacture novel bio-devices, including biosensors, interfaces, tissue scaffolds, drug delivery and gene therapy vector systems. In this context, exploration of the interactions between graphene nano- and micro-sheets with the sophisticated signaling machinery of nerve cells is of great importance.

Here we explore for the first time by patch clamp and fluorescence imaging the ability of graphene (GR) and graphene oxide (GO) nanosheets to interfere with synaptic signaling once hippocampal cultured neurons are exposed for one week to a growth medium containing thin sheets of such materials at 1 or 10 µg/mL. We further investigated whether, in the absence of explicit cell toxicity, such materials affected the ability of astrocytes to release synaptic-like microvesicles (MV) in pure glial cultures. Our results describe the potential of GO nanosheets to alter different modes of inter-neuronal communication systems in the CNS hinting at opportunities for novel neuromodulatory applications or highlighting subtle, but potentially unwanted, subcellular interactions.