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Biomimetic graphene for enhanced interaction with the external membrane of astrocytes

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Abstract

© The Royal Society of Chemistry. Graphene and graphene substrates display huge potential as material interfaces for devices and biomedical tools targeting the modulation or recovery of brain functionality. However, to be considered reliable neural interfaces, graphene-derived substrates should properly interact with astrocytes, favoring their growth and avoiding adverse gliotic reactions. Indeed, astrocytes are the most abundant cells in the human brain and they have a crucial physiological role to maintain its homeostasis and modulate synaptic transmission. In this work, we describe a new strategy based on the chemical modification of graphene oxide (GO) with a synthetic phospholipid (PL) to improve interaction of GO with brain astroglial cells. The PL moieties were grafted on GO sheets through polymeric brushes obtained by atom-transfer radical-polymerization (ATRP) between acryloyl-modified PL and GO nanosheets modified with a bromide initiator. The adhesion of primary rat cortical astrocytes on GO-PL substrates increased by about three times with respect to that on glass substrates coated with standard adhesion agents (i.e. poly-d-lysine, PDL) as well as with respect to that on non-functionalized GO. Moreover, we show that astrocytes seeded on GO-PL did not display significant gliotic reactivity, indicating that the material interface did not cause a detrimental inflammatory reaction when interacting with astroglial cells. Our results indicate that the reported biomimetic approach could be applied to neural prosthesis to improve cell colonization and avoid glial scar formation in brain implants. Additionally, improved adhesion could be extremely relevant in devices targeting neural cell sensing/modulation of physiological activity.

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