Bio-modified Graphene as glial interface to study astrocytes growth and function in vitro

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Abstract

Astrocytes are non-excitable cells that, in the human brain, have crucial physiological role to maintain its homeostasis and in the control of synaptic transmission, underpinning cognitive function [1]. Nonetheless, materials and devices to be used as brain interface should properly interact with astrocytes, favoring their growth and avoiding gliotic adverse inflammatory reaction [2]. Our work is focused on the development and validation of materials interface promoting astrocytes adhesion, growth, differentiation and device technologies, targeting sensing and controlling astrocytes functionality. Graphene and graphene substrates display properties that has a huge potential as neural interface applied to the study of brain function in vivo, to identify mechanistic understandings in vitro or for the recovery of brain functionality. However, most of the studies on graphene are focused and targeted on its interaction with neurons. Here, we will present our work [3] where, we sought to validated a (bio) chemically modified GO with a synthetic phospholipid (PL) to improve interaction of graphene oxide (GO) with brain astroglial cells. When used as cell culture substrate for the growth of primary rat cortical astrocytes, newly synthesized GO-PL composite increased the adhesion of astrocytes on GO-PL substrates of five times with respect to glass substrates coated with standard adhesion agents (i.e. poly-D-lysine, PDL) as well as with respect to 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 inflammatory detrimental reaction when interacting with astroglial cells. Finally, we provide clues on the use of GO-PL as interface of device capable to modulate directly astrocytes functionality, by means of patch-clamp and calcium imaging. Our results indicated that the reported biomimetic approach shall be applied to neural prosthesis to improve cell colonization and to avoid glial scar formation in brain implants. Additionally, improved adhesion might be extremely relevant in device targeting neural cell sensing/modulation of physiological activity.

References

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[3] Durso et al., J. Mater. Chem. B, 2018, 6, 5335-5342, (2018)

Figure

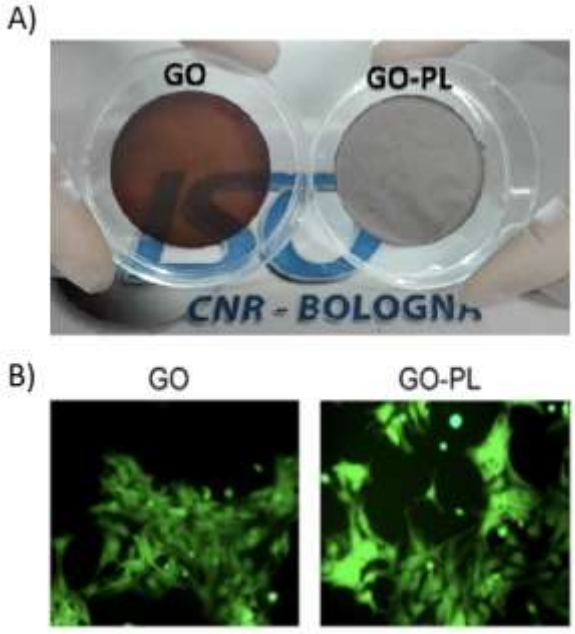

Figure 1: A) images of GO and GO-PL membranes, B) astrocytes grown on GO, left and on GO-PL, right[3]