3D Reduced Graphene Oxide Scaffolds with a Combinatorial Fibrous-Porous Architecture for Neural Tissue Engineering

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Graphene and its based materials will almost certainly integrate the next generation of neural regenerative therapies due to their remarkable proficiency to (1) work as building blocks for constructing bioactive tissue engineering scaffolds; (2) directly influence the response of both neurons and glia; (3) facilitate the delivery of drugs; and (4) boost the recording and propagation of neuronal signals.

Thus, in this study (*ACS Appl. Mater. Interfaces 2020, 12, 35, 38962–38975*), we present a 3D graphene-based scaffold able to efficiently promote the development of complex neuronal circuits *in vitro* by supporting the accommodation and infiltration of embryonic neural progenitor cells within a porous system, while enhancing the outgrowth of neurites via nanofibrous cues. Briefly, the fabrication of the scaffold relied on the manipulation of the attractive/repulsive interactions generated between the negatively charged reduced graphene oxide nanosheets and the positively charged electrospun nanofibres, leading to the formation of a hydrogel like structure suitable for rearranging a 3D fibrous-porous architecture after lyophilization. Importantly, by varying the chemical composition of the nanofibres, it was possible to adjust key features of the final construct such as its mechanical compliance, pore size distribution and structural integrity. This feasible customization could be decisive to adapt the therapeutic potential of the scaffold to the properties of the targeted neural microenvironment (*e.g.* spinal cord). Indeed, preliminary results concerning scaffold biocompatibility showed its notable capacity to guarantee high cell viability up to 14 days in culture, during which these neural progenitors preferentially differentiated into neurons able to establish highly interconnected networks.

Based on these reported findings, the research team is currently projecting *in vivo* investigations aiming to injured spinal cord regeneration.

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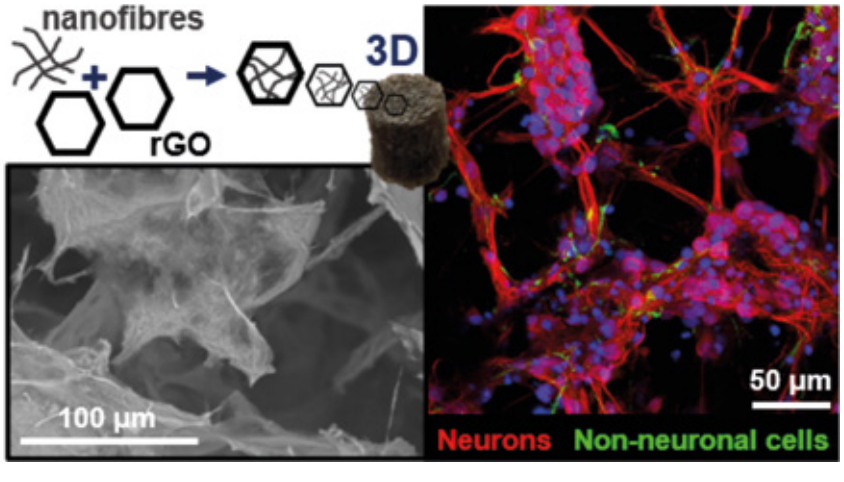

FIGURE 1
Representative scanning electron microscopy image of the 3D fibrous-porous scaffold (bottom left). Neural progenitor cells differentiation on the 3D scaffold after 14 days in culture (right): Neuronal cells labeled for MAP-2 (red), non-neuronal cells including glial cells labeled for vimentin (green) and cell nuclei labeled with DAPI (blue).