Development of Carbon Nanotubes-based Porous 3D Scaffolds for Tissue Regeneration

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Carbon nanotubes (CNTs) are one of the most promising materials to interface with electrically active tissues, as neuronal and cardiac tissues. Their inherent electrical properties and their cylindrical shape are the key features to improve and boost the cellular growth and functionality. [1]

The combination of CNT with polymers has been extensively studied, and the materials produced showed a great potential in tissue regeneration. [2] Porous 3D structures based on PDMS doped with CNTs were previously tested as supports for neuronal growth. A three-dimensional cellular organization was demonstrated to be able to induce neuronal network outputs that strongly differ from the 2D constructs and maintain the unique capabilities of CNT to tune the genuine neuronal biological processes.[3] On the other side, the design of electrodes based on conductive polymers (CPs) in brain-machine interface technology offers the opportunity to reduce gliosis, improve adaptability and increased charge-transfer efficiency. However, very little is reported about the combination of CPs and CNTs, and only 2D films have been synthesized and tested *in vitro*.[4]

In the present work, we construct 3D porous composites of CPs and CNTs and incubated astrocitic and cardiac cells to study its biocompatibility. We have developed a new, easy and fast strategy, based on the Vapor Phase Polymerization (VPP) technique, where the monomer vapor is polymerized inside a template containing CNT and an oxidant agent (Figure 1a). The physical, chemical and electrical properties were evaluated, concluding that the resulting material is a very promising scaffold, with very low density, good porosity and high biocompatibility, thus paving the way for the development of new conductive 3D scaffolds by following a yet unexploited approach.

References

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Figures

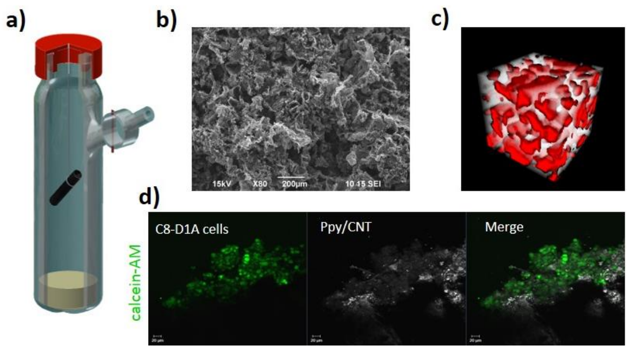

Figure 1. a) Representation of the derived- Vapour Phase Polymerization (VPP) methodology employed. b) SEM micrograph of the 3D scaffolds. c) 3D illustration of scaffold's pore distribution; pores are represented in red colour and matter in white. d) Calcein-AM stain of C8-D1A viable cells (green) after 2 days of culture.