# Nano in 3D: CNT and Conjugated Polymers for Electrosensitive Tissue Regeneration

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Three-dimensional cellular organization was demonstrated to be able to induce cellular network outputs that strongly differ from the 2D constructs. The morphology, shape and porosity are critical parameters, and electrical conductivity is an important asset when dealing with electroactive cells, such as neurons or cardiac cells.

Carbon nanotubes (CNTs) are one of the most promising materials to interface with electrically active tissues.[1] Their combination with polymers has been extensively studied, and the materials produced showed a great potential in tissue regeneration.[2] 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.[3] However, very little is reported about the combination of CPs and CNTs, and only 2D films have been synthesized and tested *in vitro*.

Here, we construct 3D porous and conductive composites, composed exclusively of CNTs and or PEDOT.[4] We developed new and easy strategies, based on chemical and electrochemical polymerizations. The resulting materials are very promising scaffolds with low density, high and homogeneous porosity, electrical conductivity and Young Modulus similar to the *in vivo* tissue. Its high biocompatibility was demonstrated by incubation of astrocytic, neuroblastoma-derived SH-SY5Y and cardiac cells. Interestingly, we also found that our scaffolds are *per se* able to induce neuron-like differentiation of the SH-SY5Y cells. Overall, we demonstrated that the hereby presented scaffolds fulfill all the requirements for the successful growth, development and regeneration of conductive cells.

## References

[1] a) Usmani, S. *et al.* (2016). *Sci. Adv.*, 2 : e1600087 b) Fabbro, A. *et al.* (2012). *ACS Nano,* 6: 2041

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[3] Bosi, S. *et al.* (2015) *Sci. Rep.,* 5: 9562

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## Figures

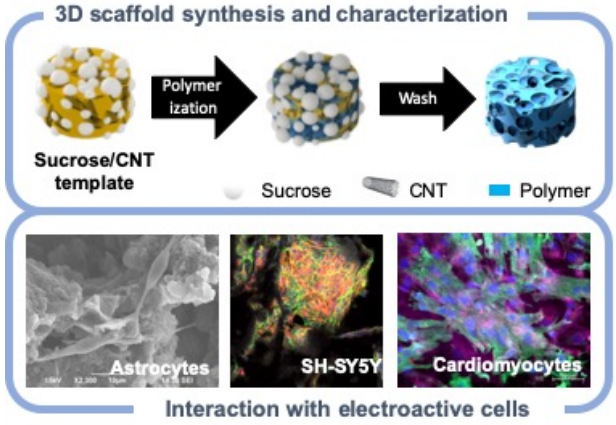


**Figure 1:** (Top) Schematic representation of the development of 3D scaffolds composed of CNT and PEDOT. (Bottom, from left to right) SEM image of the incubation of astrocytes; confocal image of the differentiated SH-SY5Y cells cultured (red: tubulin, green: cytoesqueleton); confocal image of primary co-cultureof cardiac myocytes (green) and fibroblasts (pink).