Multilayered 3D- structures from nano-assembled multilayers for biomedicine

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The development of implantable hybrid devices in a variety of biomedical applications are often inspired by the composition and complexity of native tissues. At the lowest level of such organization, one should select the adequate biomaterials to be used as the building block of the structure that will support cells and control their behaviour towards the production of new tissue. We have been proposing the use of multilayered based arrangements prepared by the layer-by-layer technique (LbL) that could be then integrated in more complex porous macroscopic devices, often exhibiting a multi-scale organization. Using adequate templates, non-flat coatings can be fabricated with tuned compositions along the build-up assembly, including porous devices. This enables the production of very well controlled multifunctional and structural devices using mild processing conditions that could be useful in biomedicine, including in tissue engineering. In particular, we have been interested in developing more complex/hierarchical porous structures using natural-based polymers that could fulfil specific requirements in such kind of applications. Often multiple cell types should be integrated in such hybrid devices to recapitulate relevant biological features necessary to trigger the regeneration process. Methodologies developed in our group will be exemplified, permitting the production of: (i) Membrane-like devices able to support the attachment and organization of cells; (ii) 3-dimensional (open) porous nanostructured scaffolds for tissue engineering, enabling the support of cells, by combining LbL and rapid prototyping technology; and (iii) multi-scale spherical objects to encapsulate cells, acting as “living” injectable or (closed porous) implantable devices.