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THREE-DIMENSIONAL LAYER-BY-LAYER STRATEGIES FOR TISSUE ENGINEERING AND NANOMEDICINE

R.R. Costa[1,2], J.F. Mano[1,2]

1- 3B's Research Group - Biomaterials, Biodegradables and Biomimetics, University of Minho, Headquarters of the European Institute of Excellence on Tissue Engineering and Regenerative Medicine, AvePark, 4806-909 Taipas, Guimarães, Portugal
2- ICVS/3B's - PT Government Associate Laboratory, Braga/Guimarães, Portugal

Layer-by-layer (LbL) is a self-assembly-driven surface modification strategy that allows the construction of nanostructured films onto substrates of any geometry, from simple bidimensional surfaces to more complex three-dimensional porous scaffolds. The principle behind LbL lies in the existence of multiple intermolecular interactions, such as electrostatic contacts, hydrophobic interactions, and hydrogen bonding, where the cooperative effects of multipoint attractions play the most important role. It is a technique that offers ease of preparation, versatility, fine control over the materials structure and robustness under physiological conditions [1].
Although LbL has been mostly limited to the modification of planar surfaces, its potential lies in the capability to be extrapolated to 3D structures and coat increasingly complex geometries. Currently trending is the use of spherical templates – sacrificial or non-sacrificial – for applications in Nanomedicine, such as the construction of drug carriers or for the encapsulation of cells. The nanostructured nature of multilayered coatings makes it possible to build containers which permeability to molecules may be tuned simply by varying the number of involving layers or the class of materials involved. This way, in drug delivery it would be possible to construct structures in which the permeability of a drug to the exterior could be adjusted to a specific application or therapy, such as non-systemic approaches to cancer [2]. In cell encapsulation, multilayer films could be employed to grant immune protection to the encapsulated biological materials, such as pancreatic islet cells, and enhanced control of both transport properties and surface physicochemical characteristics [3]. Therefore, LbL presents an ambitious step in the development of effective encapsulating barriers for both active agents and cells.

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