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10.10 - Recent Advances in Additive Biomanufacturing

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Abstract

The principles of tissue engineering and regenerative medicine have been used for the development of innovative medical therapies for engineering tissues and organs. These therapies involve the use of biomaterials, cells, and biologically active molecules, according to two fundamental strategies: the top-down and bottom-up approaches. Top-down approaches, which are the most commonly used, involve the implantation of porous scaffolds, with or without living cells and bioactive agents, into the defect site in the patient. In these approaches, scaffolds act as temporary templates for the seeded cells, mimicking the properties of the native extracellular matrix and providing an adequate environment for the growth of the new tissue. Scaffolds can be produced by using either conventional or additive techniques, resulting in structures with different levels of porosity, pore size, interconnectivity, and spatial distribution. Additive biomanufacturing techniques allow significantly more control over the scaffold characteristics (e.g., architecture, porosity, permeability, etc.), enabling the automatic and reproducible fabrication of scaffolds in a wide range of polymeric, ceramic, and composite materials. Some of these techniques also allow the fabrication of constructs encapsulating living cells. This chapter describes the most recent advances in the top-down approach to fabricate scaffolds for tissue regeneration, presenting the most important additive biomanufacturing techniques and processable materials. Future perspectives in the field and challenges for future research are also discussed.

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