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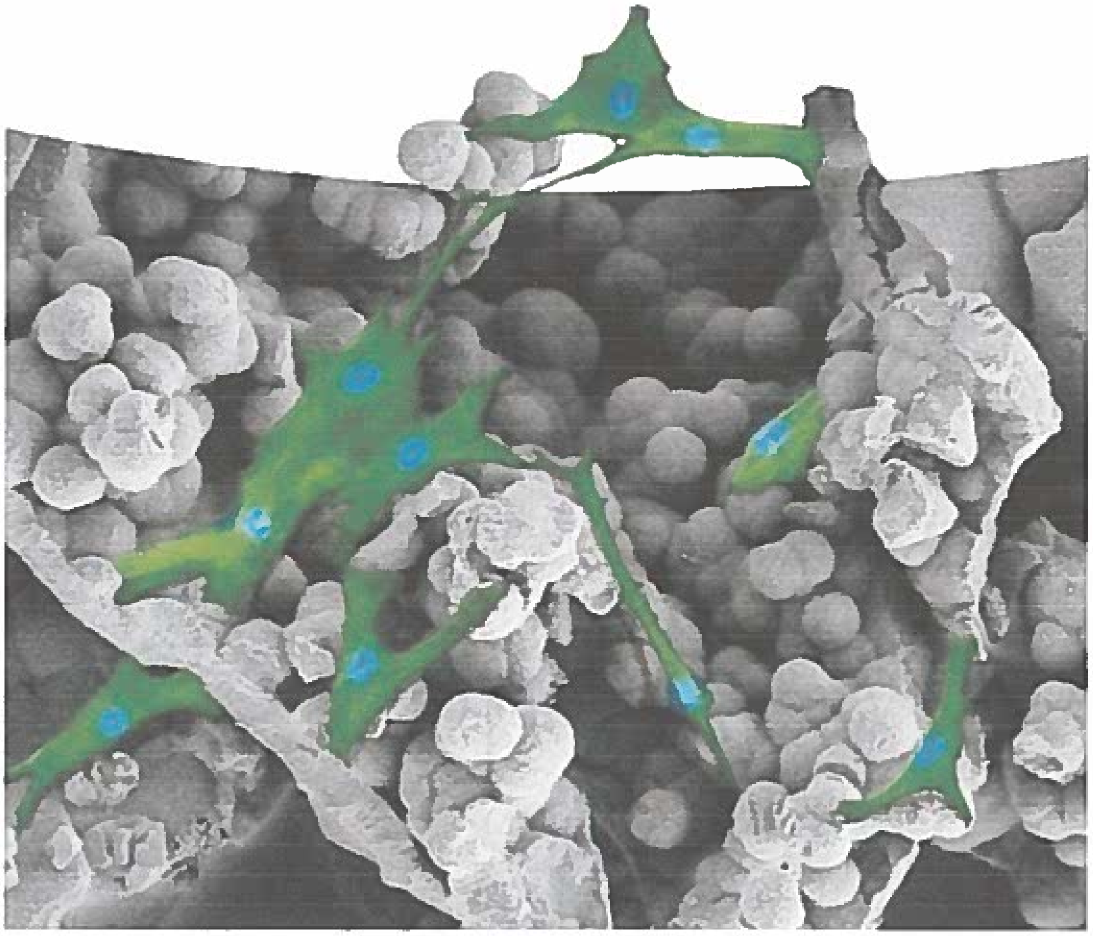
and José Carlos Rodríguez-Cabello

Biomaterials Surface Science



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Bioactive and Smart Hydrogel Surfaces

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8.1
Introduction

Biomaterial scientists have been inspired by nature in their research on polymers. In nature, all biological systems are dynamic, changeable, and very flexible to the alterations in their environment. Efforts are underway to mimic this easy way to face up to the external changes with smart polymers.

Smart polymers, also called *stimuli-sensitive polymers*, respond in an extreme manner to even slight changes in their environment. The peculiarity of these materials lies not only in the macroscopic changes (shape, surface features, solubility, and sol-to-gel transition among others) but also in the reversibility of these transitions. The environmental cues can be changes in temperature, pH, ionic concentration, presence of metabolic chemicals, and so on [1].

From a biomedical application point of view, and specifically from tissue engineering, the most attractive polymers are pH- and temperature-sensitive ones. Therefore, soluble pH and thermosensitive polymers that overcome gel transition at physiological temperature and pH have been proposed as minimally invasive injectable systems. In this way, hydrogels constitute an alternative therapeutic treatment without invasive surgical procedures [2].

Hydrogels are water-swellable, water-insoluble polymeric materials, which form a three-dimensional network of polymeric chains that are cross-linked by chemical or physical bonding and display tissue elastic properties, constituting a scaffold where cells can grow in [3].

In order to make hydrogels more similar to the extracellular matrix (ECM), it is important to take into consideration the huge number of cellular interactions and communication events that takes place between the cell and the surroundings. For instance, there is evidence that topographical features such as ridges, grooves, and curvature can affect cell adhesion, migration, morphology, and even proliferation, pointing to an important role for the incorporation of topographical cues in tissue scaffolds. Modifying the patterned surface of the hydrogel, with different

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