Abstract

This thesis has focused mainly on the synthesis and characterization of biostable macroporous polymers from the family of polyacrylates, for application in regenerative medicine. Scaffolds and membranes developed in this work can have different applications in regenerative medicine that require the transplantation of cells to the organism. In particular, ring of cornea prosthesis, anchorage of bone prosthesis, articular cartilage, and dressing for stem cell transplantation on skin regeneration or treatment of corneal and mouth ulcers.

For this purpose, initially poly (ethyl acrylate) (PEA) copolymers films, with different and controlled physicochemical properties were pre-pared through via radical polymerization. In order to know some of the physical and thermal properties that might affect the proteins ad-sorption, determining differences between surface properties (topography, chemistry and surface energy) and subsequent cell adhesion, a characterization of the obtained films was performed, by finding the degree of wettability, swelling and the presence of phase separation in the material, by measuring the contact angle (WCA), water absorption and differential scanning calorimetry (DSC), respectively.

Subsequently, thin porous membranes with suitable structural and mechanical properties that allow cell colonization and proliferation inside the network and biostables in the human body were developed. To obtain the membranes with well interconnected pores that reach the requirements to be used in prosthetic implants and transplants of cells, a method combining the template technique and the anisotropic pores collapse was designed.

Processing method, microstructure and mechanical properties of the synthesized membranes was analyzed, through scanning electron microscopy (SEM), scanning confocal laser microscopy, stress-strain experiments in tension and tearing strength measurements, yielding a thin and strong three-dimensional porous membrane.

Two biological characterizations were performed by seeding bone marrow mesenchymal stem cells on poly (ethyl acrylate) copolymers with different

hydrophilicity degrees and different cross-linking densities. Seeding efficiency, cell viability and proliferation was analyzed. Morphology and cell adhesion type at short times culture was observed by fluorescence microscopy, and cell proliferation capacity a long times culture by Confocal fluorescence microscopy. A good initial cell adhesion in the porous thin membranes compare to their respective membranes was observed. For larger time culture the cells were able to adhere and expand over all porous membranes, and in addition they exhibited high proliferation in surface after 21 days of culture.

Moreover, corneal prosthesis prototype following a core-skirt type model was developed. Starting from an anchorage ring with flexible and porous structure of poly (ethyl acrylate), in which center a rigid and transparent lens of poly (methyl methacrylate) (PMMA) was polymerized, generating the integration of both components on a single piece.

Finally, in collaboration with other research groups, the adhered fi-bronectin (FN) by adsorption or grafting and its biological response on films of poly (ethyl acrylate) copolymers was evaluated. Further-more, the influence of the properties of polymeric materials in fibronectin adhesion and its conformation by exposure of some cell adhesive motifs that interact with integrin's was analyzed. The adhesive motifs under study and quantified by enzyme-linked immunosorbent assay ELISA, were the arginine-glycine-aspartic acid sequences, RGD, and FNIII7-10 adhesion domain. The importance of the presence of a small fraction of functional groups at the surface of a polymeric substrate on protein adsorption and exhibition of adhesion motifs that cells can recognize has been shown. On the other hand, the application of the membranes, after being seeded with adipose-derived mesenchymal stem cells, in order to be used as a macroporous sup-port in a corneal prosthesis has been studied, and their behavior in an animal model has been demonstrated.