Abstract

The need for bio-stable polymers for fabrication of prosthetic implants is evidenced, among other indicators, by the proliferation of currently marketed devices. The physico-chemical characterization and biological response of a set of bio-stable polymeric materials is the ultimate goal of this thesis.

In this work we have synthesized various polymeric materials of the family of acrylates and methacrylates subtly varying surface characteristics, such as degree of hydrophilicity or distribution of electric charges. The procedure consisted of radical copolymerization of ethyl acrylate, EA, and 2-hydroxyethyl acrylate HEA, and methacrylic acid, MAAc.

We have characterized the materials in its dry state and in the presence of different water contents by differential scanning calorimetry, DSC, dynamic mechanical analysis, DMA, atomic force microscopy, AFM, dielectric analysis, DRS, equilibrium water content, EWC and surface energy, SE, pursuing the objective of ascertaining whether the water is able to induce conformational changes in the polymer chains leading to a phase separation.

On materials in the form of spherical porous scaffold with interconnected pores fibroblasts and endothelial cells were cultivated. The compatibility of the endothelial cells was measured in terms of cell viability and suitable endothelial differentiation and function. Cultures were made from primary human endothelial cells, HUVEC, and it was determined whether their morphology and function were affected by the material. Adhesion and proliferation of HUVEC were examined, as well as an important marker of endothelial activation, E-selectin. We assessed the normal endothelial function phenotypes observed and maintained *in vivo* by analysis of the cell-cell contacts and the regulation of gene expression of the activation marker E-selectin when a stimulus (LPS) was added.

Further, as potential application of these materials in a prosthetic artificial cornea, and since stromal fibroblasts of the cornea (i.e., keratinocytes) are relevant in the healing of the cornea the effect of hydrophilicity of substrate to adhesion of a human fibroblasts cell line, MRC-5, was determined. MRC-5 is a cell model to study the arrangement of the cytoskeleton after joining the different media by detecting F-actin.

Epithelial cells have been seeded onto these substrates as well, evaluating their behaviour/cell function as one of the essential requirements for a successful keratoprosthesis implantation is that creating and maintaining a layer of epithelial cells that prevent bacteria enter into the eye and allow diffusion tear layer stably over time. Thus, cell parameters have been assessed such as adhesion, proliferation and viability of a line of human conjunctiva epithelial cells, NHC, grown on polymer substrates with different degrees of hydrophilicity and surface electric charges seeking what degree of hydrophilicity of the substrate allows epithelialisation and could give the material flexibility and hydrophilicity required for better contact with eyelids and tear.

The results have been correlated with the adsorption and conformation of a protein of the extracellular matrix, fibronectin.