Amino Acid-Functionalized Polyelectrolyte Films as Bioactive Surfaces for Cell Adhesion

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Surfaces were prepared with polyelectrolyte derivatives of poly(styrene-alt-maleic anhydride) (PSMA) functionalized with amino acids of different hydropathy indices, with the aim of evaluating the effect of the chemical functionality of polyelectrolytes on SH-SY5Y neuroblastoma cell adhesion. Functionalizing PSMA derivatives with l-glutamine, l-methionine, and l-tyrosine yielded PSMA-Gln, PSMA-Met, and PSMA-Tyr polyelectrolytes, respectively. We first studied the adsorption behavior of PSMA functionalized with amino acids on silicon wafer surfaces modified with 3-aminopropyltriethoxysilane at pH 4.0 and 7.0 and at low and high ionic strengths. The highest rate of polyelectrolyte adsorption was at pH 4.0 and high ionic strength and was higher with the glutamine and tyrosine films. The advance contact angles (?A) of the polyelectrolyte surfaces showed a moderate effect of ionic strength and pH on polyelectrolyte film wettability, with PSMA-Tyr being slightly more hydrophobic. Atomic force microscopy images of the polyelectrolyte surfaces

showed two types of morphology: the well-defined globular nanostructure of PSMA-Met and PSMA-Tyr and densely packed nanofibrous-like structure of PSMA-Gln. The highest level of ionic strength caused a slight decrease in the size of the nanostructure that formed the surface domains, which was reflected in the degree of surface roughness. Cell adhesion assays with the polyelectrolyte film showed that SH-SY5Y neuroblastoma cells cultured on PSMA-Met present a well-extended morphology characterized by a stellate shape, with five or more actin-rich thin processes, whereas SH-SY5Y cells that were seeded on PSMA-Gln and PSMA-Tyr have a round morphology, with fewer and shorter processes. These results indicate that it is possible to modulate the surface characteristics of polyelectrolyte films based on their chemical functionality and environmental parameters such as pH and ionic strength in order to evaluate their effect on cell adhesion. Thus, surfaces prepared from polyelectrolytes functionalized with amino acids are an attractive and simple platform for cell adhesion, which can be used in developing biomaterials with modulated surface properties.

amino acid

cell adhesion

functionalization

polyelectrolytes

SH-SY5Y neuroblastoma

Amino acids

Atomic force microscopy

Cell adhesion

Cells

Crystal atomic structure

Film preparation

Morphology

Nanostructures

pH effects

Polyelectrolytes

Proteins

Silicon wafers

Styrene

Surface roughness

3-aminopropyltriethoxysilane

Chemical functionality

Effect of ionic strength

Environmental parameter

Functionalizations

Neuroblastomas

Polyelectrolyte adsorption

Surface characteristics

Ionic strength

amino acid

maleic acid derivative

nanomaterial

poly(styrene-alt-maleic anhydride)

polyelectrolyte

polymer

polystyrene derivative

cell adhesion

chemistry

drug effect

human

infrared spectroscopy

pH

scanning electron microscopy

surface property

tumor cell line

ultrastructure

wettability

Amino Acids

Cell Adhesion

Cell Line, Tumor

Humans

Hydrogen-Ion Concentration

Maleates

Microscopy, Electron, Scanning

Nanostructures

Polyelectrolytes

Polymers

Polystyrenes

Spectroscopy, Fourier Transform Infrared

Surface Properties

Wettability