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Polysaccharide-based nanostructured multilayers with distinct sulfated and aminated composition to improve cells response and biomineralization

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In vitro cell expansion, differentiation for further cell transplantation and biomaterials-cell fundamental assays are still performed more often on inert 2D surfaces than on 3D culture. 3D systems do not allow an easy cell monitoring and may demand higher cell density, being more costly and time consuming. Inert surfaces (polystyrene, biodegradable thermoplastics or metals) neither resemble the extracellular matrix (ECM) milieu nor trigger intercellular signaling. Several studies are focused on surface modification and on the correlation of the surface properties such as roughness, wettability and chemistry with cell behavior with regard to the effects on cell adhesion, morphology, proliferation, survival and differentiation.[1,2] Proteins, hormones, small peptides, cytokines, inorganic molecules, sulfated and non-polysaccharides (PS) compose the natural 3D ECM milieu. PS vary on the sulfur content, sulfonic group (Sg) position and on base units. Sulfonated and sulfated PS have intrinsic very high affinity towards growth factors and positively charged molecules through the functional groups turning the combination of them very bioactive hybrids mats. Current surface modification models make the transposition to 3D systems complicate. Layer-by-Layer (LbL) assembling is a versatile technique to coat any 2D/3D structure with polyelectrolytes (PE) which coatings properties can be modelled and controlled. Herein, LbL was employed to develop 2D models to verify the ability of sulfated and aminated coatings to improve cell function using PS form marine origin: chitosan (Chi) and carrageenans (Cars). Chi and Cars have equivalent functional groups to the ones that are naturally found in the ECM: $-NH_2$, $-OSO_3H$, and -OH. CHI and κ, ι and λ Car (1, 2 and 3 Sg, respectively) nanocoatings were assessed by QCM-D, modelled by the Voigt-model, and characterized by AFM, SEM and XPS[3]. The properties of the multilayers can be controlled as well the relative amount of the positive versus the negative PE. Moreover, the effects on biomineralization of SaOs-2 cell line were investigated. The coatings, specially ι Car coatings, increased significantly alkaline phosphatase activity and biomineralization of SaOs-2 cell line. The results indicated that the coatings do not only attract medium ions but also enhance osteogenic cell function. These models are interesting to study cell-materials interactions where surfaces culture with increased biofunctionality can be developed.

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