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Editorial

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Bio-interfaces: At the Junction of Material Science and Biology

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Research in the area of bio-interfaces is rapidly growing due to its unique position at the junction of material science and biology, while on the other hand due to its applications in biomedicine, biology and drug delivery [1,2]. Designing advanced coatings, tissue engineering, implants or simply substrates for cell culture handling requires extensive knowledge of the interaction of bio-molecules, their mechanical stability and surface functionalization. Nanotechnology, in general, and a closely related area of layer-by-layer [3] films [4-6] are well positioned for taking on challenges of interfacing material science and biomedicine. Some of the most significant advantages of the layer-by-layer technique are its versatility and multifunctionality.

Recently developed method of controlling the interaction of the constituent layers, for example hyaluronic acid and poly-l-lysine, allowed to build thick, bio-compatible films [5]. A very big advantage of such films is their reservoir-like capacity to enclose bio-molecules as well as controllable diffusion of biomolecules in such films. Modification of such films with silver nanoparticles for SERS detection has been recently shown [6], while we have recently demonstrated functionalization of such films by gold nanoparticles [7]. Such a modification allows for selective surface modification of these films by remote laser irradiation [7], which can also serve the purpose of controlling mechanical properties of such films. Mechanical properties, which are investigate by the so-called colloidal probe approach [8], are very important parameter of substrates and coatings since they alone can differentiate growth and proliferation of cells and tissue cells [9]. Peculiarly, even addition of gold nanoparticles without remote activation can be used to control films' mechanical properties. Films with higher stiffness are produced by increasing the concentration of gold nanoparticles on their surface. In fact, the E-modulus of such films was observed to increase from less than 300 MPa to more than 900 MPa (over three fold increase) by addition of 900 µl of gold nanoparticle solution [10]. On the other hand, this increased stiffness of films can be used for controlling protrusion of embedded particles. Since such bio-films represent some of the most biocompatible coatings they are very attractive candidate for processing other particles and drug delivery carriers. For example, they can be used for selective masking of particles and capsules adsorbed onto their surface. And if the nanoparticles alter the stiffness of the films, then it is expected that particles or capsules adsorbed to their surface would protrude differently depending on the concentration of nanoparticles. Such an approach represents a facile method to control the patchiness of particles in a completely biocompatible process [10]. Alternatively, mechanical properties control of films can be achieved by polyanions mixture [11], while their modification can be performed with microcapsules [12].

The ultimate goals of research in this area include designing novel bio-interfaces and improving cells growth. As such, implementation of such goals would open new ways of designing optimized coatings for tissue engineering. Further functionalization of such surfaces with bio-molecules as well as with nanoparticles for remote activation are expected to open novel routes for controlling cell adhesion and film based drug delivery [13,14]. It is expected also that such films and bio-interfaces can be adapted for and incorporated into biochips, thus enabling additional venues for surface functionalization and modification.

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