Remote and direct plasma processing of cells: how to induce a desired behavior

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The interplay between plasma processes and the biological environment is a long and intriguing story that spans different applications from surface modification of biomaterials to the direct interaction of plasma with cells. This makes plasma processes a very powerful tool in such distant biomedical fields as tissue engineering and sterilization. In vitro cell culture experiments represent the best way to fully understand the more subtle and fundamental interactions between the chemical species produced by plasma processes and cells. In this presentation the use of cell lines will be highlighted since it allows a high reproducibility and control of results[1]. Three main items, ranging from low pressure plasma modifications of 2D and 3D materials to Dielectric Barrier Discharges (DBDs) directly on cells, will be addressed.Due to their versatility in tailoring surface properties of materials used in different applications, cold plasma processes are utilized to dictate the interactions of proteins, cells, and biological tissues with biomaterials, membranes and biomedical devices, to induce desired cell responses. For example, the behavior of Saos2 osteoblast-like cells on surfaces with different roughness and morphology, produced by RF glow discharges, fed with hexafluoropropylene oxide[2], will be shown. In case of 3D objects, such as scaffolds for tissue engineering, the aim of the surface modification is to allow cell colonization of the entire substrate since usually a higher cell colonization at the scaffold periphery and inadequate colonization at its core have been reported [3]. It will be shown how this has been achieved using a sheath with chemical characteristics different from those of the core. Porous polycaprolactone scaffolds, fabricated by solvent casting/particulate leaching technique, were plasma-coated with PEO-like coatings, having different cell unfouling characters [4]. Finally, the direct effect of DBDs applied directly on two different cell lines will be shown. For the same process applied to different cell lines; a primary line: NHDF fibroblasts, and an immortal line: Saos2 osteoblasts, varying results on cell proliferation and morphology have been observed. A stimulatory effect was observed on NHDF cells while in case of Saos2 inhibition of cell adhesion and growth was directly dependent on the increase of plasma doses. The obtained results demonstrate that by properly tuning the dose of exposure of cells to air plasma, it could be possible to induce selective effects on cell growth of different cell types. This would in turn be useful in different fields of medicine such as treatment of cancer, wound healing and tissue regeneration.

References

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