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Commercialisation pathways for plasma-activated coatings, plasma immersion ion implantation and plasma-polymerised nanoparticles in biomedical science

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Globally, biomedical researchers are hampered in reagent, consumable and product development by the inability of functional biomolecules to bind to polystyrene, glass and other important materials. Functional biomolecules - used in products ranging from diagnostics to cell culture to drug delivery systems - are most often physisorbed to the surface, meaning their attachment is relatively weak and that they may be washed off during use. To overcome this, linker chemistry is frequently used, however this is typically performed on an individual biomolecule basis, often involves toxic chemicals and is largely focused on the attachment of proteins to specific surfaces. The development of plasma-based systems to embed or coat surfaces with radicals capable of covalently binding to biomolecules offers a significant step forward in overcoming the poor biomolecule-surface attachment hurdle. Crucially, these plasma processes also make the surfaces hydrophilic enabling immobilised biomolecules to maintain function. We have recently developed plasma-activated coatings (PAC) on flat glass and non-flat geometry cell culture polystyrene consumables as well as plasma ion immersion implantation (PIII) of paramagnetic microparticles. During the plasma treatment for PAC, plasma-polymerised nanoparticles can also be generated. All four of these plasma applications result in surfaces which can rapidly and covalently bind to biomolecules including proteins, carbohydrates, lipids, DNA, RNA, vitamins, drugs and fluorescent molecules, all with a simple incubation of the biomolecule and the surface. Within an hour of incubation, functional biomolecules are covalently bound without the need for other reagents or wet chemistry. This technology is now in various stages of commercialisation including: the manufacturing of PAC-treated cell culture plates for cellular immunotherapy and cellular agriculture; PAC-treated bioassay and immunoassay plates to improve diagnostics; PAC-treated borosilicate glass for improving cell culture on surfaces optimal for microscopy; PIII-treated magnetic microparticles for intracellular cell sorting; and plasma-polymerised nanoparticles for flow cytometry, vaccine development and drug delivery. This presentation will focus on the application of these plasma technologies in the design and manufacturing of novel, superior products driven by the needs of biomedical industry partners.

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