Plasma models applied to polymer deposition and surface control for biological applications

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Thin films of polymers can be deposited using plasma enhanced chemical vapour deposition [1] and their surface chemistries greatly affect biological response. The deposition process depends on the type of precursor and gas mixture, the plasma coupling mode (capacitive or inductive), the plasma geometry (symmetric or asymmetric) and on the main operating parameters (i.e. frequency, gas pressure, gas flow, gas inlet position). The complexity of the precursors and the lack of basic reaction rates imply that a detailed understanding of the plasma bulk, plasma sheath and plasma-surface properties can not simply be derived. However a global model of these plasmas can often be developed by using argon cross sections to evaluate the dominant parameters and validate some of the experimental findings[2,3]. The latter are usually obtained using performant surface diagnostics with high spatial resolution.

Here we present some of the modeling studies found in the literature and summarize essential parameters in global models. As an example we develop a global model (in argon) for a low frequency capacitively coupled asymmetric glow discharge plasma polymerisation device used for one step multifunctional micropatterning of surfaces[4]. The plasma parameters estimated from the global model are discussed and compared to the chemical physical and topological properties of the surface. The latter result from a patterned live electrode which dominates the plasma process (here essentially a sheath process). The process produces multifunctional, selective surface chemistries capable of controlled protein adhesion, geometric confinement of cells and the spatial confinement of enzyme mediated peptide self-assembly.

References

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