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Atmospheric Pressure Plasma Interactions with Complex Biomedical Surfaces

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Many plasma medical processes and fabrication of biomedical devices begin with an atmospheric pressure plasma interacting with a complex surface. These surfaces are complex by virtue of their topography and structure, (non-planar, micro- and nano-features, porosity), chemistry (organic), phase (liquid) and feedback to the source (self-organization). At one extreme, these complexities can be leveraged to produce desired outcomes. For example, complex multiphase plasma-liquid interactions can be leveraged to specify chemical activity of droplets for plasma activated water (PAW). At the other extreme, the variability of surface topography and chemistry will likely require real-time-control to provide reproducible results.

In this presentation, atmospheric pressure plasma interactions with complex biomedical surfaces will be discussed with results from computational investigations using multi-dimensional and global models. Examples will be taken from plasmas interacting with solid surfaces having micro-structure and porosity, plasma treatment of liquid surfaces and droplets, and plasma functionalization of biomedical device materials. The challenges of treating complex biomedical surfaces, and active means to address those challenges, will be discussed with examples from plasma treatment of hair follicles, a technique being developed for pre-operative skin sterilization.

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