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**Cold atmospheric plasma sterilization: from bacteria to biomolecules**

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Although ionized gases have been known to have biological effects for more than 100 years, their impact on the practice in healthcare service became very significant only recently. Today, plasma-based surgical tools are used for tissue reduction and blood coagulation as surgical procedures. Most significant however is the speed at which low-temperature gas plasmas are finding new applications in medicine and biology, including plasma sterilization, wound healing, and cancer therapies just to name a few. In the terminology of biotechnology, the "pipeline" is long and exciting. This presentation reviews the current status of the field with a particular emphasis on plasma inactivation of microorganisms and biomolecules, for which comprehensive scientific evidence has been obtained. Some of the early speculations of biocidal plasma species are now being confirmed through a combination of optical emission spectroscopy, laser-induced fluorescence, mass spectrometry, fluid simulation and biological sensing with mutated bacteria. Similarly, fundamental studies are being performed to examine cell components targeted by gas plasmas, from membrane, through lipid and membrane proteins, to DNA. Scientific challenge is significant, as the usual complexity of plasma dynamics and plasma chemistry is compounded by the added complication that cells are live and constantly evolving. Nevertheless, the current understanding of plasma inactivation currently provides strong momentum for plasma decontamination technologies to be realized in healthcare. We will discuss the issue of protein and tissue contaminations of surgical instruments and how cold atmospheric plasmas may be used to degrade and reduce their surface load. In the context of plasma interaction with biomolecules, we will consider recent data of plasma degradation of adhesion proteins of melanoma cells. These adhesion proteins are important for cancer cell migration and spread. If low-temperature plasmas could be used to degrade them, it could form a control strategy for cancer spread. This adds to the option of plasma-triggered programmed cell death (apoptosis). Whilst opportunities thus highlighted are significant and exciting, the underpinning science poses many open questions. The presentation will then discuss main requirements for plasma sources appropriate for their biomedical applications, in terms of the scope of up-scaling, the ability to treat uneven surfaces of varying materials, the range of plasma chemistry, and the control of plasma instabilities. Finally a perspective will be offered, in terms of both opportunities and challenges.

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