Plasma-generated Species and its Effect on Surface Chemistry and Morphology of Polymers exposed to Atmospheric Pressure Plasma - A Prospective Application for Biomedical Purposes

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Nowadays the use of non-thermal physical plasmas in the field of medicine is intensively investigated for sterilization, wound healing, and surface modification of biomedical materials. It is well known that a number of reactive species, including UV photons, positively and negatively charged ions, electrons, and radicals, emitted by plasmas can have very different impacts on the exposed substrate. Therefore, a fundamental understanding of the plasma-based mechanisms in the gas discharge as well as on the substrate surface is required for appropriate applications of plasma sources.

The influence of atmospheric pressure plasma on the chemical und morphological surface properties of bio-relevant polymers has been investigated. Besides changes in the O/C ratio of the plasma-exposed polymer, followed by the creation of oxygen-containing functionalities, significant alteration of the surface topographies, in particular roughening of the surfaces, were observed. Especially, the admixture of oxygen to the argon plasma led to an increased etching of the surface resulting in the formation of etching depths of several micrometers. Furthermore, this study analyses the correlation between the plasma-based modification on polymeric surfaces and the reactive species emitted by the gas discharge. For the plasma diagnostics optical emission spectroscopy (OES) and two-photon absorption laser-induced fluorescence (TALIF) were applied. The obtained results indicate a correlation of the etching depth and the surface roughness with the concentration of oxygen atoms. Moreover, it has been found, that the observed radial etching profile is due to the presence of plasma-generated oxygen species. Deduced from these results multiple applications of the used plasma jet are feasible. Additionally to plasma-based bio-decontamination, a promising application of this plasma device could be the removal or etching of organic substances, e.g. biofilms, from surfaces. Since, biological remnants of biofilms (dead bacteria) after conventional cleaning procedures are capable to entertain inflammatory processes in the adjacent tissues, the complete removal and not only the killing of pathogen is mandatory. Hence, this contribution further shows the efficacy of non-thermal plasma on etching of 7-day old *Candida albicans* biofilms depending on the operating gas and the treatment time.