GEC14-2014-020047

Abstract for an Invited Paper
for the GEC14 Meeting of
the American Physical Society

Comparison of Plasma Activation of Thin Water Layers by Direct and Remote Plasma Sources[1]

MARK KUSHNER, University of Michigan

Plasma activation of liquids is now being investigated for a variety of biomedical applications. The plasma sources used for this activation can be generally classified as direct (the plasma is in contact with the surface of the liquid) or remote (the plasma does not directly touch the liquid). The direct plasma source may be a dielectric barrier discharge (DBD) where the surface of the liquid is a floating electrode or a plasma jet in which the ionization wave forming the plasma plume reaches the liquid. The remote plasma source may be a DBD with electrodes electrically isolated from the liquid or a plasma jet in which the ionization wave in the plume does not reach the liquid. In this paper, a comparison of activation of thin water layers on top of tissue, as might be encountered in wound healing, will be discussed using results from numerical investigations. We used the modeling platform nonPDPSIM to simulate direct plasma activation of thin water layers using DBDs and remote activation using plasma jets using up to hundreds of pulses. The DBDs are sustained in humid air while the plasma jets consist of He/O2 mixtures flowed into humid air. For similar number of pulses and energy deposition, the direct DBD plasma sources produce more acidification and higher production of nitrates/nitrites in the liquid. This is due to the accumulation of NxOy plasma jets, the convective flow removes many of these species prior to their diffusing into the water or reacting to form higher nitrogen oxides. This latter effect is sensitive to the repetition rate which determines whether reactive species formed during prior pulses overlap with newly produced reactive species. in the gas phase. In the plasma jets, the convective flow removes many of these species prior to their diffusing into the water or reacting to form higher nitrogen oxides. This latter effect is sensitive to the repetition rate which determines whether reactive species formed during prior pulses overlap with newly produced reactive species.

[1]Work supported by National Science Foundation and Department of Energy.