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Plasma liquid chemistry in the presence of atomic oxygen - implications for plasma medicine[1]

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Plasma-generated hydroxyl radicals (OH) and oxygen atoms (O) produced by the COST jet, a micro-scaled atmospheric pressure plasma jet, were investigated using a variety of experimental techniques [1]. Several gas admixtures were studied to distinguish the contributions of the two reactive oxygen species (ROS) to chemical modifications, investigated by EPR spectroscopy and an HTA fluorescence assay. Additionally, hydrogen peroxide (H_2O_2) was quantified in various liquids treated with the COST jet. Large discrepancies in H_2O_2 formation were observed depending on the treated solution. Reactive species produced in the gas phase were shown to enter the liquid and efficiently react with molecules present in aqueous solution. In particular, molecules present in buffer and cell media widely used in plasma medicine can have a considerable impact on species production in the liquid [2]. Here, the cell culture medium RPMI and the buffer KNO_3 are in focus. The difference in H_2O_2 production is discussed on a cell culture example [3] and different biological outcomes depending on the used liquid. Furthermore, reaction pathways for the process gases helium, helium with an oxygen admixture, and helium with a water admixture will be discussed, yielding opportunities to tune plasma-induced chemistry to produce desired species. The author would like to thank Brayden Myers, Pietro Ranieri, and Tatyana Smirnova for their contributions. [1] Myers et al., PhysChem ChemPhys, submitted; [2] Bekeschus et al., Scientific reports 7.1 (2017): 1-12.; [3] Ranieri et al., Applied Sciences 10.6 (2020): 2025.

[1]All EPR measurements were made in the Molecular Education, Technology, and Research Innovation Center (METRIC) at NC State University.