Plasma-liquid interactions: overview and perspectives

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The interaction of liquids with low temperature atmospheric pressure plasmas has been investigated intensively due to its large potential in many applications including plasma-aided decomposition of recalcitrant organic pollutants in water, plasma medicine and material synthesis [1]. These applications leverage the unique ability of plasmas to deliver large fluxes of highly reactive plasma species to liquids. The strong coupling between the plasma and the liquid phase can lead to huge changes in the local plasma properties in the vicinity of the liquid phase while significantly enhancing the complexity of the underpinning processes. This coupling does not only impact the transport of reactive species into the liquid phase, the driving force behind many applications, but can also impact plasma dynamics, stability, and kinetics.

In this presentation, we will report experimental studies on the impact of evaporation on the electron kinetics near the plasma-liquid interface and the development and suppression of plasma instabilities in the presence of a liquid electrode [2]. We will further explore plasma-enabled liquid phase chemistry and show that we can develop quantitative models to describe plasma-induced redox reactions for selected molecules, interactions with biological matter and the synthesis of gold nanoparticles [3,4,5]. We will extend these case studies to currently unexplored liquid phase reactions, highlight some areas that require further research and provide a perspective for opportunities in the field.

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