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Atmospheric Pressure Plasmas Incident onto Thin Liquid Layers[1]

WEI TIAN, SETH NORBERG, NATALIA YU. BABAEVA, MARK J. KUSHNER, University of Michigan — The interaction of plasmas with liquids has increasing importance in advanced manufacturing and biomedical applications. Sustaining atmospheric pressure plasmas *on liquids* (as opposed to *in liquids*) can increase the chemical activity of the liquid by transferring more easily produced reactive species from the gas phase into the liquid. Often the intent is to treat the surface under the liquid layer, as in plasma medicine. The liquid then acts as a filter which modifies the fluxes of reactive species prior to reaching the underlying surface. The liquid in turn influences the plasma by evaporation which produces a saturated layer of, for example, water vapor above the liquid surface, or by the shape of liquid covered wounds and the dielectric properties of the liquid. Direct plasma exposure (e.g., a dielectric barrier discharge) enables intersection of ion and UV/VUV fluxes with the liquid surface whereas many remote plasma jets typically do not. This increases the rate of hydronium (H_3O^+) production which affects pH. In this paper, results from a computational investigation on the dynamics of atmospheric pressure plasmas intersecting thin water layers having dissolved gases and proteins will be discussed. Examples are taken from DBD and plasma jet exposure of water layers over a tissue-like dielectric, and plasmas sustained in bubbles in water. The mutual interaction of the plasma and liquid will be discussed based on radiation and ion transport into the water, evaporation, and transport and conversion of plasma produced reactivity through the water layer.

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