Canadian Association of Physicists

Association canadienne des physiciens et physiciennes

Contribution ID: **289** Type: **Invited Speaker / Conférencier(ère) invité(e)**

(I) Controlling Non-thermal Plasmas in Contact with Liquids

Wednesday 9 June 2021 12:45 (25 minutes)

The success of non-thermal plasmas in a broad range of applications in materials, medicine, and for the environment lies in their high reactivity at non-equilibrium conditions [1]. Cold atmospheric pressure plasma sources operated with air or noble gases allow plasma treatment at ambient conditions. Plasmas can thus induce novel chemistry into sensitive environments such as nano-scaled structures and biological organisms. In many of these environments, liquid interfaces play a major role, mediating the plasma interaction effect [2].

Applications in biomedicine, nanotechnology and material processing, and environmental science range from wound healing, to assisting cancer therapy, to surfactant free nano-particle synthesis, to water purification. Especially, the clinical results of therapeutic application of plasmas have increased worldwide research in plasma medicine [3]: It has been found that plasma can produce those reactive oxygen and nitrogen species which are known to play a vital role in cell communication. These essential plasma-generated species form a reaction system with complex pathways.

For targeted plasma-application, a precise control of plasma chemical pathways is necessary: Tailoring the plasma chemistry is possible when reaction pathways especially of transient highly reactive species are known. These transient species, which exist only for fractions of a second, initiate all subsequent reaction chains. The talk will address how to identify dominant pathways within the complexity of the respective plasma caused chemical reaction kinetics taking into account the entire plasma-liquid system [4]. Sub-nanosecond dynamic processes can be unravelled with ultrafast non-linear laser spectroscopy, studying turbulent phenomena and stochastic interaction processes at the interfaces. Based on these insights, non-equilibrium physico-chemical processes can be developed that are otherwise only achievable either with by-products of severe ecological impact or at high temperatures not applicable for modification of sensitive systems such as living organisms.

References:

[1] X. Lu, et al., Reactive species in non-equilibrium atmospheric-pressure plasmas: Generation, transport, and biological effects, Physics Reports, 1, 630 (2016)

[2] P.J. Bruggeman, et al., Plasma–liquid interactions: a review and roadmap, Plasma Sources Science and Technology, 053002, 25 (2016)

[3] T. von Woedtke, et al., Plasmas for medicine, Physics Reports, 291, 530 (2013)

[4] S. Reuter, et al., The kINPen—a review on physics and chemistry of the atmospheric pressure plasma jet and its applications, Journal of Physics D: Applied Physics, 233001(51), 51 (2018)

Author: REUTER, Stephan (Polytechnique Montreal)

Presenter: REUTER, Stephan (Polytechnique Montreal)

Session Classification: W2-4 Application of Atmospheric Pressure Plasmas I (DPP) / Applications des plasmas à pression atmosphérique I (DPP)

Track Classification: Plasma Physics / Physique des plasmas (DPP)