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Atmospheric pressure plasma measurement and control: challenges and recent advances

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Precise measurements, plasma reproducibility and control of plasma properties are equally important for fundamental investigations and the development of next generation plasma technologies. This is particularly challenging in atmospheric pressure plasmas due to small dimensions on micron scales, the possible influence of impurities and pronounced dynamics requiring temporal resolution of picoseconds. This presentation will discuss recent advances using radiofrequency atmospheric pressure plasmas as example [1]. These plasmas are efficient sources for reactive species [2]. The non-equilibrium chemical kinetics is initiated by the electron dynamics. Due to the strongly collisional environment and associated short electron energy relaxation times the electron dynamics can be tailored using multi-frequency power coupling, enabling separate control of key parameters like electron density and electron mean energy [3]. Measurements and predictive simulations of key reactive species are equally challenging due to the strongly collisional environment and their multi-scale nature in space and time. The most promising approach is the exploitation of complementary advantages in direct measurements combined with specifically designed numerical simulations. The employed diagnostic techniques include picosecond laser spectroscopy, synchrotron VUV spectroscopy, UV absorption spectroscopy and nanosecond optical imaging spectroscopy [4-6]. The presentation will focus on examples of He-O_2-N_2-H_2O mixtures for bio-medical applications using a recently developed COST Reference Plasma Source [1].

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