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Tailoring the electron dynamics and chemical kinetics in radio-frequency driven atmospheric pressure plasmas[1]

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Radio-frequency atmospheric pressure plasmas are versatile and efficient sources for reactive species at ambient room temperature. The non-equilibrium chemical kinetics is initiated and determined 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 techniques, enabling separate control of key parameters like electron density and electron mean energy. Details of the chemical kinetics depend on the feedgas composition and desired application. 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, IR absorption spectroscopy and nanosecond optical imaging spectroscopy. The presentation will focus on examples of He-O_2-N_2 mixtures for bio-medical applications and He/Ar-CO_2 mixtures for CO_2 conversion into value-added chemicals.

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