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DELIVERING FLUXES OF REACTIVE SPECIES OF COLD ATMOSPHERIC-PRESSURE PLASMAS THROUGH THE ELECTRODE SHEATH REGION

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Cold atmospheric-pressure plasmas have received much attention; mainly rely on the potential use of reactive species generated in such plasmas. In most cases of application, such as plasma medicine, the reactive species have effects on a sample only after their penetration through the plasma sheath that is formed above the sample. In contrast to studies of generation and optimization of reactive species with the plasma itself, much less research has been reported on delivering of reactive species through the sheath region. The latter is quantitatively investigated in this paper for radio-frequency plasmas in atmospheric He+O₂ mixture, by means of a fluid model. It is found that the electrode fluxes of plasma species are dominated by the plasma sheath, because the diffusion length is very small as a result of high collisionality at atmospheric pressure. So, the fluxes of reactive plasma species can be controlled by adjusting the sheath, which in turn can be controlled by altering, for example, the excitation frequency, the applied voltage, and the electrode gap. At a constant input electrical power, it is shown that high fluxes of reactive plasma species, particularly anions such as O₂⁻, may be facilitated by low excitation frequency, small gap distance, or voltage bias applied to an electrode. This effect is particularly pronounced when the sheath thickness becomes comparable to the electrode gap distance.

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