

Positive streamer propagation due to background or photo ionization: Experiments and theory

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Positive streamers in air are generally believed to propagate against the electron drift direction due to the nonlocal photo-ionization reaction. Photo-ionization is the ionization of O₂ molecules by UV radiation from excited N₂ molecules; therefore this reaction depends on the ratio between oxygen and nitrogen. Another possible source of free electrons in front of a positive streamer is background ionization that can remain from previous discharges, or it can be created by cosmic rays or by radioactive species like radon. We study the effects of both photo- and background-ionization on propagation and morphology of positive streamers by changing the ratio between nitrogen and oxygen and by changing the repetition frequency. We also study streamers in pure nitrogen with a small addition of radioactive ⁸⁵Kr to increase background ionization. While streamer velocities are amazingly insensitive to these changes, their overall morphology largely depends on gas composition, repetition rate and radioactive admixtures. Essential observations can be explained theoretically.

References

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