

Electron Swarm Parameters and Electron-neutral Collisional Cross-sections of Eco-friendly SF₆-Alternative Gases

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Sulfur hexafluoride (SF₆) is a favored insulating gas widely used in electric equipment, but it has a severe greenhouse effect. Recently, significant progress has been made in identifying and testing promising alternative gases to SF₆.^[1] This talk aims to provide better insight into these SF₆-alternative gases by focusing on the determination of their electron swarm parameters and electron-neutral collisional cross-sections, which are fundamental parameters that determine their dielectric strength and discharge properties.

Firstly, recent advances in the electron swarm parameters of SF₆-alternative gases will be discussed. The principles of steady-state Townsend (SST) and pulsed Townsend (PT) measurements considering electron kinetics will be introduced, and the dielectric strengths of various gases compared.^[2-3] Figure 1 shows the layout schematic of a pulsed Townsend experimental setup for measuring the electron swarm parameters.

Secondly, an efficient method for determining swarm parameters from PT principle considering ion kinetics by parallel genetic algorithm on GPU platform will be proposed. The ion kinetics of some SF₆-alternative gases will be presented and the impact of ion-involved reactions on the dielectric strength of gases at higher pressures will be discussed.

Thirdly, a complete and self-consistent electron-neutral collision cross-section set for C₄F₇N

molecule will be provided through implementing a standard electron swarm procedure that involves adjusting cross-sections of the initial set to progressively improve agreement between calculated swarm parameters and experimental data.^[4] Additionally, a machine-learning strategy to help determine the cross-section set will also be introduced.

Finally, this talk shall introduce some outlooks and ongoing studies, including the concept of azeotropic synergistic gas mixture as a way for seeking SF₆-alternative gases. This work is supported by the National Natural Science Foundation of China under Grant No. 52277162.

References

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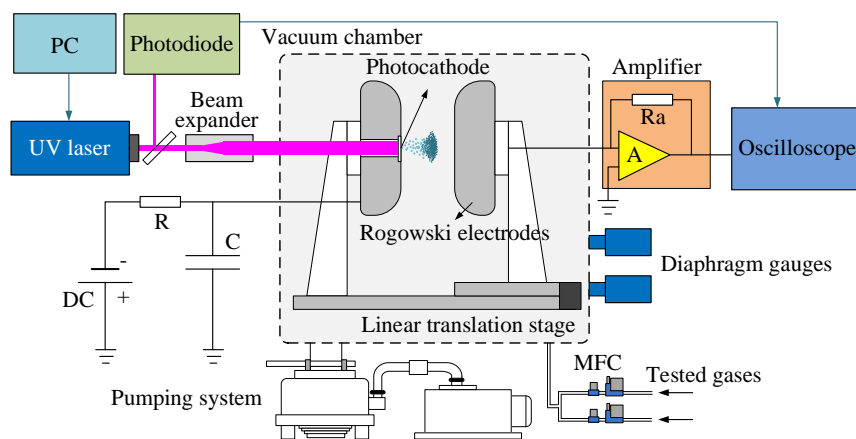


Figure 1. The layout schematic of a pulsed Townsend experimental setup for measuring the electron swarm parameters.