Publ. Astron. Obs. Belgrade No. 103 (2024), 29 *Progress Report*
https://doi.org/10.69646/aob103p029

ELECTRON TRANSPORT AND NEGATIVE IONIZATION FRONTS IN STRONGLY ATTACHING GASES

JASMINA ATIĆ and SAŠA DUJKO

Institute of Physics Belgrade, Pregrevica 118, 11080 Belgrade, Serbia
E-mail jasmina.atic@ipb.ac.rs

Abstract. To optimize and understand the process of gas insulation in power transmission and distribution systems, we study electron transport, and the inception and propagation of negative ionization fronts in strongly attaching gases. The calculations are carried out not just for the familiar gaseous dielectrics, including SF_6, but also for the new generation of gaseous dielectrics that are known to have low global warming potentials and minimal impact on the Earth's atmosphere. Examples include CF_3I, $C_3H_2F_4$ and C_4F_7N.

Electron swarm transport coefficients are calculated using a multi term theory for solving the Boltzmann equation and Monte Carlo simulations (Dujko *et al.* 2010). We found significant discrepancies between the flux and bulk transport coefficients, which vary from a few percents to a few orders of magnitude. Perhaps the most striking phenomenon is the occurrence of negative differential conductivity in SF_6 and CF_3I only in the *E/N*-profile of the bulk drift velocity (Mirić *et al.* 2016). The mixture of $C_3H_2F_4$ and SF_6 exhibits positive synergy, with an increase in the critical electric field of the mixture to values higher than those for each gas separately. The inception and propagation of negative ionization fronts are studied by the classical fluid model in 1D and 1.5D setups. The classical model has been extended and generalized by expanding the source term in the equation of continuity in terms of powers of the number density gradient operator. We calculate the electron density, densities of positive and negative ions, electric field, and velocity of ionization fronts for a range of pure gases and gas mixtures at various *E/N*.

Acknowledgments: This work is supported by the Science Fund of the Republic of Serbia, Grant No. 7749560, Exploring ultra-low global warming potential gases for insulation in high-voltage technology: Experiments and modelling EGWIn.

References

Dujko S., White R.D., Petrović Z.Lj., and Robson R.E. : 2010, *Phys. Rev. E*, **81**, 046403.
Mirić J., Bošnjaković D., Simonović I., Petrović Z. Lj., and Dujko S. : 2016, *Plasma Sources Sci. Technol.*, **25**, 065010.