Measurements and determination of breakdown voltage in DC discharges at low pressure

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Breakdown measurements in non-equilibrium discharges in gases and vapours provide insight into elementary processes (ionization, secondary electron emission, surface interactions) that participate in discharges, which can be crucial in the development and optimization of new and existing applications of non-equilibrium discharges. In our experiment, the breakdown voltage is determined by igniting discharge in a low-current regime and extrapolating the Volt-Ampere characteristic to zero-current [1,2]. While the advantage of this technique is in the elimination of overvoltage in the pre-breakdown, it can have limitations under certain conditions due to oscillations of voltage and current in the Townsend regime of discharge.

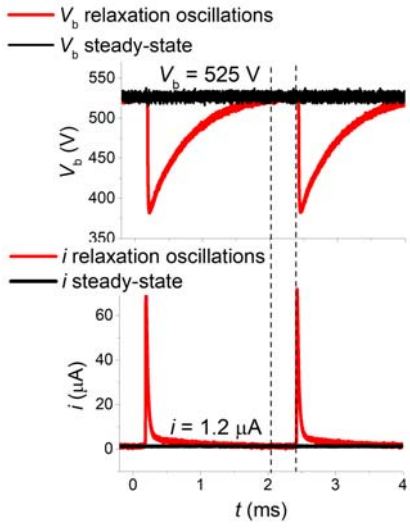

Figure 1. Estimation of breakdown voltage from relaxation oscillations in water vapour.

Here we present a method of estimation of breakdown voltage from relaxation oscillations in the Townsend regime of discharge [1]. The main feature of such oscillations is that the current briefly passes through the high-current mode and then relaxes to the Townsend low-current mode. The breakdown voltage can be estimated from the part of the period corresponding to the lowest current values (fig.1). The reproducibility and reliability of results were tested in conditions in which it was possible to obtain a breakdown, both in steady-state mode and in oscillations for similar discharge parameters, by varying the elements of the electrical circuit. Results were also verified by time-resolved ICCD imaging of the discharge emission. The presented technique enables breakdown measurements in a considerably wider range of gas pressures and electrode gaps.

References

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