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Bipolar Pulsed Atmospheric DBD with Extremely Steep Voltage Slopes

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In Dielectric Barrier Discharge (DBD) at atmospheric pressure can be observed at least four different time scales for different processes: electronic excitation/ionisation (1ns – 100ns), de-excitation (1µs to 100µs), ionic reactions (10ns to 10µs) and neutral particle reactions (1µs to 1ms). In order, to influence the mechnisms voltage pulses with extremely steep slopes are necessary. Therefore, the rise time and the pulse width of the applied voltage could be used as additional parameters to influence the processes inside the DBD.
The required bipolar voltage is generated either with an H-bridge or a solid-state Marx topology. The H-bridge is realized with high-voltage switches, which consists of series stacked MOSFETs with an appropriate balancing network and a high precision gate drive unit. The Marx topology consists of several identical Marx stages. Each Marx stage consists of five MOSFETs and one capacitor as well as a high precision gate drive unit for the MOSFETs. With both approaches the necessary bipolar output voltages with extremely steep voltage slopes as well as high repetition rates can be achieved. Rise times of 20ns from 0V to 10kV are achieved with the H-bridge and 40 ns with the Marx topology. The repetition frequency with both topologies is up to $1kcs^{-1}$ with adjustable duty cycles.
The pulse-form as well as the ratio pulse-width/pause-width of the applied voltage has a strong impact on the DBD. This was shown by time resolved light emission measurements of the DBD in air at atmospheric pressure in dependence on the pulse-/pause-widths of the applied voltage. The light emission measurements were performed in different spectral ranges to get insights for excitation/de-excitation mechanisms. At small pulse-widths (1µs-range) and small pause-widths (1µs to 20µs) light intensity amplification could be observed. The light emission measurements obtained by pulsed DBD are compared with those obtained in a conventional DBD driven with sinusoidal voltage at $40kcs^{-1}$.

Keywords
DBD
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