Influence of volume and surface processes in dielectric barrier discharges

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Dielectric barrier discharges are one of the most commonly used discharge types for applications at atmospheric pressure. Due to the dielectric in between the electrodes, surface charges are build up by the discharge which cause the attenuation of the electric field across the discharge gap. As a consequence, the discharge extinguishes and a transition to an arc discharge is prohibited. This mechanism keeps the gas temperature low, which is important for surface treatment of polymers and biological surfaces, or for temperature sensitive reaction products, e.g. ozone.

Depending on geometry, gas mixture, and the shape of the applied voltage, different discharge phenomena and operation modes appear. The phenomena can vary from arbitrary distributed filaments to patterned and diffuse discharges. As well, the discharge mechanism varies from streamer to glow-like and Townsend-like discharge breakdowns. Especially, the pre-ionization before the breakdown and the surface charge distribution on the dielectrics play a key role for structure formation and the preferred discharge mode. Under this aspect, the contribution summarises several experiments performed in the collaborative research center TRR24. Examples are streak camera measurements of the breakdown in nitrogen-oxygen gas mixtures using unipolar high voltages, the laser photodetachment in helium-oxygen barrier discharges, and the measurement of surface charges and their influence on the discharge.

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