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Titel of the dataset

Streamer propagation dynamics in a nanosecond

pulsed surface dielectric barrier discharge in He/N2

mixtures

Authors / data creators

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Required access level

Public access

Reason for the required access level

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Related publications

Please give the link (DOI) to related publications.

Description of the data set (abstract)

An atmospheric pressure surface dielectric barrier discharge (SDBD) in

helium-nitrogen mixtures is investigated experimentally using phase-resolved optical

emission spectroscopy (PROES) and computationally employing a two-dimensional

simulation framework. A good qualitative agreement between experiments and

simulations is found. It is shown that by applying microsecond or nanosecond

driving voltage waveform pulses, the discharge exhibits filamentary or homogeneous

structures. The time evolution/propagation of the homogeneous surface ionization

wave for different nitrogen admixtures, pressures, and applied voltage is studied and

analyzed. Both, simulations and experiments indicate that for the positive applied

voltage pulse, a streamer possessing the typical dynamics of the positive streamer is

ignited on the powered side of the electrode. At the same time, on the grounded

sides, two streamers are formed: one possessing the dynamics of a negative streamer,

which propagates towards the center of the cell of the electrode grid, and a positive

one in the opposite direction. It is also shown that the positive streamers on the

powered side are partly responsible for the velocity of the negative streamers on the

grounded side as simulations show a deceleration of the negative streamers as soon as

two positive streamers collide and then close to the meeting point vanish due to the

repulsive electrostatic interactions between them. Additionally, from the time-resolved

measurements of the emission signal, the quenching rate constants of the He-I (3s)3S1

state by collisions with helium and nitrogen are determined to be 9(±4)×10−12 cm3s−1

and 3(±1) × 10−10 cm3s−1, respectively at T = 400 ± 50 K.

Plasma source

Twin SDBD electrode, consists of a rectangular

α-Al2O3 plate (Alumina Systems GmbH, Germany). The plate has a length, width,

and thickness of 190 mm × 88 mm × 0.635 mm. This plate acts as the dielectric barrier

between two symmetrically silk printed metal square mesh lattices, which are used as the electrodes. These metal electrodes consist of an 8–18 μm thick MoMn core, with a

2–6 μm thick Ni coating. The lattice traces are 0.450 mm wide, approximately 0.020 mm

thick, and are evenly spaced every 10 mm. This forms the 150 mm × 50 mm square

lattice with a cell size of 10 mm × 10 mm, resulting in a total of 75 cells.

Plasma medium

The discharge is operated in helium (5.0 purity) with nitrogen (5.0 purity) admixture. The combined flow rate of helium and nitrogen is maintained at 2 slm, while the mix rates are varied. The temperature is roughly room temperature.

Plasma target

No target used.

Diagnostics / modelling

Experimental PROES (Phase resolved optical emission spectroscopy)

Simulated 2D plasma-fluid simulation is performed

using the nonPDPSIM platform developed by Mark Kushner

Resources

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