# CAPILLARY NANOSECOND DISCHARGE IN MOLECULAR GASES:HIGH ELECTRIC FIELDS AT HIGH SPECIFIC DEPOSITED ENERGY

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Strongly non-equilibrium plasma at high electric fields and high specific deposited energy was studied in capillary nanosecond discharge in 20 Torr $N_2$:$O_2$ mixtures. The discharge developed in the quartz capillary with inner diameter 1.5 mm and length 80 mm. The capillary was inserted into the break in the coaxial cable at the distance 25 m from the high-voltage generator (FID FPG 10-MKS20 HV, FID GmbH). Pulses of 20 kV amplitude on the electrode, 30 ns FWHM and 4 ns rise time were repeated with a frequency of a few Hz to accumulate the signal; gas flow rate provided change of the gas in the capillary between two pulses. Calibrated back current shunts where used to measure current, voltage in the cable and energy stored in plasma. The electric field was measured by capacitive gauge and from optical emission spectroscopy. For emission spectroscopy measurements, the Acton spectrometer (SP-2500i, 1200 I/mm grating, Princeton Instrument) was combined with Pi-Max4 (Princeton Instruments) ICCD camera or with UV and IR photomultipliers (Hamamatsu). Measurements of oxygen atoms in the discharge and afterglow (t<100 ns) were carried out by actinometry, using 5% of Ar addition as actinometer. Two-photon absorption laser induced fluorescence (TALIF) was used to measure O-atoms density in the late afterglow (t<1000 ns).

Measured specific deposited energy in the discharge was as high as 0.5-1.0 eV/molecule, the electric field on the stage of maximum energy deposition was in the range of 200-400 Td. It was shown that kinetics in the discharge requires taking into account reactions of interaction between charged/dissociated and excited species. High quenching of electronically excited species by electrons was observed in early afterglow [1]. Dissociation degree of oxygen in the discharge reached tens of percent, increasing to 100% at microseconds due to reactions between $O_2$ and electronically excited nitrogen. Heating of the gas up to a few thousand K was observed at the time scale less than VT-relaxation due to energy release in collisions with electronically excited species.

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## REFERENCES

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