# Electric field evolution in surface nanosecond dielectric barrier discharge

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The electric field in nanosecond surface dielectric barrier discharge (SDBD) was measured under different pressures (1-5 bar). The discharge was initiated in synthetic air by positive polarity pulses 19 kV on the high-voltage electrode, 30 ns FWHM, 3-5 ns rise time, in the regime of 10 Hz repetitive frequency. Spatial distribution of the electric field was measured as well as its evolution during the pulses. It is a necessary step before using SDBD for ignition of the combustible mixtures.

The surface barrier discharge emission in synthetic air at different pressures (1-5 bar) was studied with the help of spectroscopy. The molecular nitrogen emission at 337.1 nm and 391.4 nm was used to calculate the electric field. The method we used to process the spectroscopic data and to obtain the field value is described in [1-2]. The schematic of the experimental setup is presented in fig. 1.

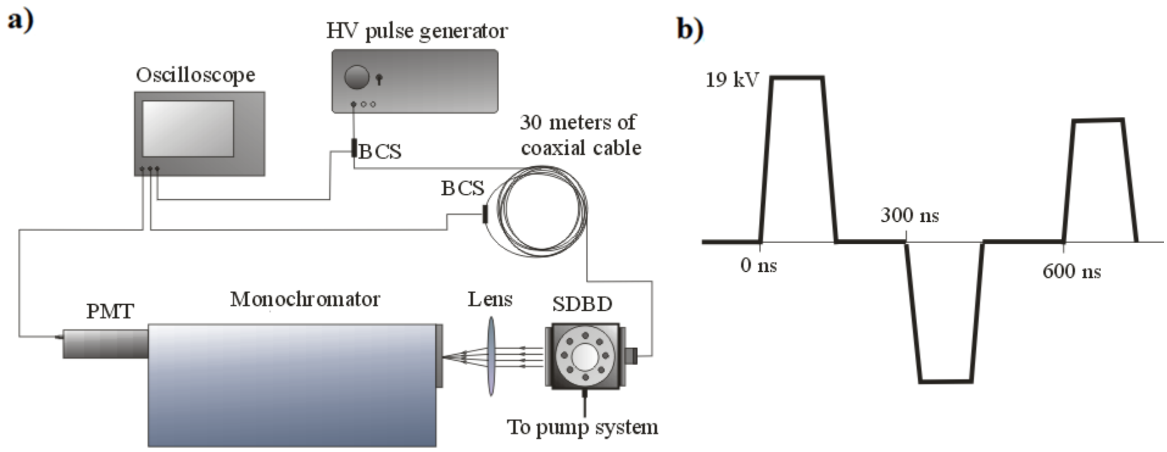


Fig. 1 (a): experimental setup. BCS – back current shunt. PMT – photomultiplier tube; (b): signal on the high-voltage electrode. First pulse – incident positive pulse, second and third – generator-reflected pulses.

Coaxial geometry electrode system with 0.3 mm PVC film as a dielectric was used to initiate the disharge in dry air. Four concentric diaphragms of different diameters were used to select the radiation. The difference in external and internal diameter of each diaphragm was 2 mm, and the diaphragms were installed at the distances 0, 3, 6, and 9 mm from 20 mm diameter high-voltage electrode.

The emission was focused onto the entrance slit of Andor 500i monochromator (1200 $mm^{-1}$ grating, 1.65 nm/mm dispersion) with 100-mm focal distance quartz lens. Photomultiplier tube Hamamatsu H6610 was connected to the output slit of the monochromator. The signal was registered by LeCroy oscilloscope. The pulse voltage was measured using back current shunt installed 15 m apart from the discharge gap in 50-Ohm cable connecting the high-voltage generator and the discharge cell.

The signal from the current shunt was also used to trigger the oscilloscope, so, signals at 337.1 nm and 391.4 nm were synchronized in time. Review emission spectra were taken in the wavelength range 334-338 nm and 388-392 nm. To select the wavelength intervals of interest we determined the widths of the entrance slit of the monochromator, which were equal to 1.840 mm and 1.050 mm respectively. The output slit was significantly smaller (0.1 mm). The relative calibration of the intensity at two wavelengths of interest was made using deuterium lamp (ORIEL 63163).

Fig. 2 (a) represents the intensities for wavelength of 337.1 nm and 391.4 nm. These data were obtained for 2 atm at 6 mm from the HV electrode. Fig. 2 (b), (c), (d) represent the evolution of the electric field under the same conditions for different pulses (see fig. 1 (a)).

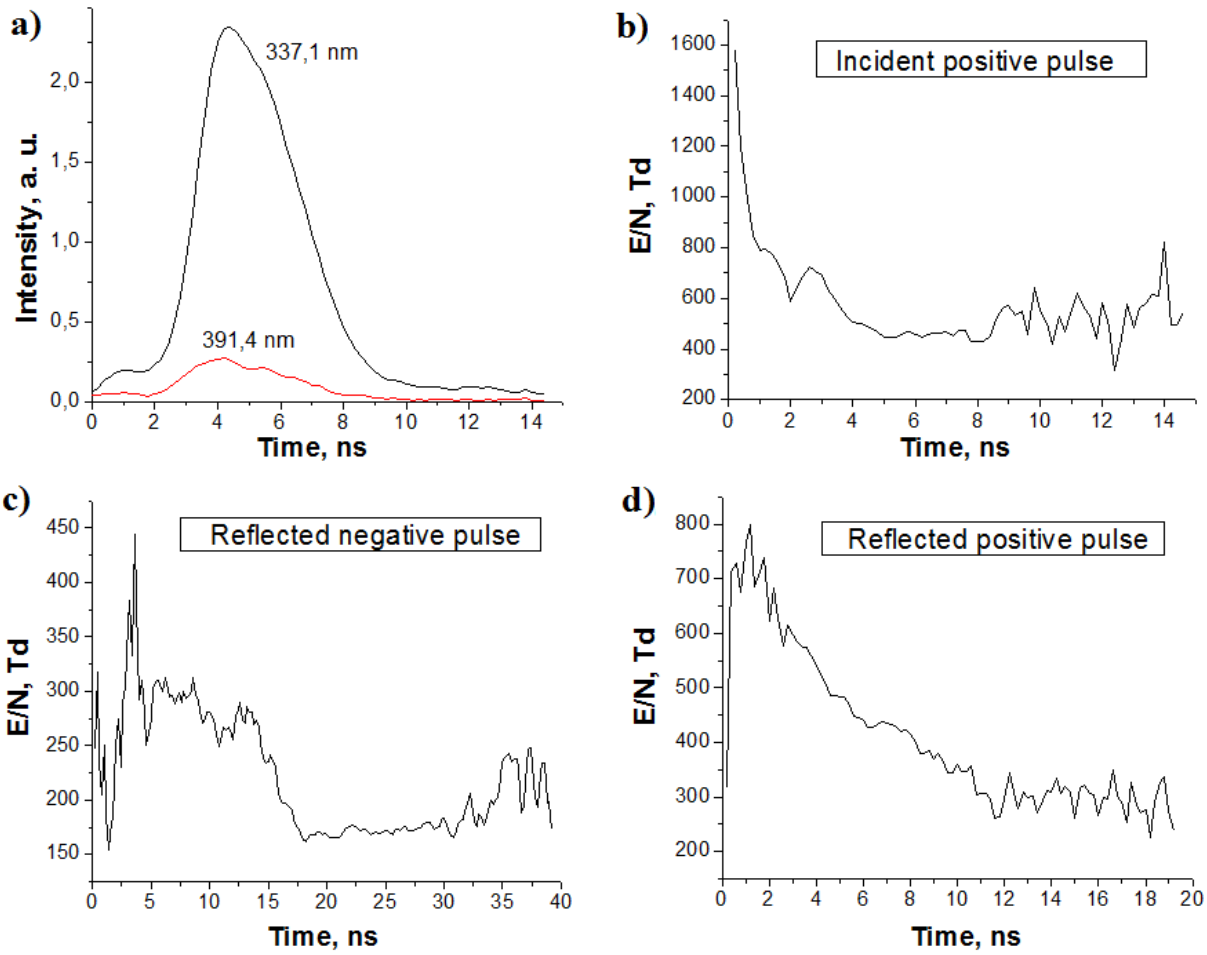


Fig. 2 (a): rate of intensities for wavelength of interests during incident positive pulse; (b): electric field evolution during incident positive pulse; (c): electric field evolution during negative reflected pulse; (d): electric field evolution during reflected positive pulse.

There is a significant difference between $E/n$ evolution for positive and negative polarities. Characteristic value of the electric field at 2 atm for positive pulses is significantly higher than for negative pulse. Meanwhhile our research shows that the ratios between electric field in different pulses strongly depend on pressure in discharge cell.

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## References

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