Introduction

Most high voltage pulsers used to drive dielectric barrier discharges (DBDs), produce a single pulse shape (width and voltage), making it challenging to assess the effect of pulse shape on the production of different chemical species during a discharge. Eagle Harbor Technologies (EHT), Inc. has developed a nanosecond pulser that allows for independent control of the output voltage, pulse width, and pulse repetition frequency. Through the use of this technology, presented here is a characterization of reactive species generated by the DBD under the independent variation of voltage (0-20 kV), frequency (0-10 kHz) and pulse width (20 - 180 ns). A better understanding of this parameter dependency can allow for more targeted and effective application of plasma in medical, environmental, industrial, and other applications.

EHT Nanosecond Pulser

EHT has developed a customizable, high voltage nanosecond pulser with independently adjustable output voltage, pulse width, and pulse repetition frequency for producing non-equilibrium plasmas like pseudosparks, dielectric barrier discharges, atmospheric pressure plasma jets, and other cold atmospheric plasmas. The pulser used for this experiment had the following parameters:

- Output voltage: 0 - 20 kV
- Pulse width: 20 - 260 ns
- Pulse repetition frequency: Single Pulse - 10 kHz (CW)
- Rise time: 20 ns (load dependent)
- Power: 120 W

Experimental Setup

EHT constructed several DBD and DBD-like plasmas. The pulser used for this experiment had the following parameters:

- Power: 120 W
- Rise time: 20 ns (load dependent)
- Pulse repetition frequency: Single Pulse - 10 kHz (CW)
- Operation at different pulse widths clearly shows intensity variation of O and H lines, but not He lines

Atmospheric Plasma Pencil DBD-like Jet

A DBD-like ‘plasma pencil’ consisted of an outer bar electrode around a 0.25” quartz tube and a copper pin inner electrode. Helium gas flowed through the quartz was ionized with 12 kV nanosecond pulses at a variety of PRFs and pulse widths, interacting with neutrals to produce spectra.

Atmospheric Arc

An arc was created between copper electrodes with a 1 mm spacing with 15 kV nanosecond pulses 1 kHz and a variety of pulse widths. The results indicated that varying the pulse width allows for isolation of various arc phases, and therefore selecting for relative intensities of different spectral lines.

Conclusion

Under each of the discharge conditions investigated, variation of pulse parameters was shown to affect the spectral signature of the plasma. In particular, the ratio and intensity of different reactive species can be altered by the manipulation of pulse width within the tested range of ~20 ns-180 ns. Increasing PRF in the regime investigated (1-10 kHz) was seen to increase the intensity of the spectral data, and altering voltage allowed breakdown to be achieved without damaging the experimental setup. The degree of independent parameter variability inherent to the EHTs NSP pulsers is key for applications that benefit from control of reactive species creation or experimental parameters.

Further Information

For a copy of this poster please visit http://www.eagleharbortech.com.