Abstract

A dielectric barrier discharge (DBD) is an electrical discharge that occurs between a pair of electrodes with at least one dielectric material between them. The discharge that forms in DBD’s are known as microdischarges, which are small discharges that typically have a radius of 0.1 mm and travel on a timescale of less than 100 ns. The properties of the dielectric material used in DBD’s can influence the formation of the discharge. For example, a low density porous dielectric material may have discharges that tend to form in a particular area where a small hole exposes the electrode that is directing current. Other properties such as gas composition, pressure, electrode separation distance, and the applied-voltage frequency/waveform can influence the properties of the discharge.

Problem Statement

This research project investigates whether 3D printing are capable of printing quality electrical components. This is tested by printing electrodes for a DBD while analyzing various properties of the discharge that form. The thickness of the electrodes and the density of the Alumina are the only parameters that are altered in the experiment. Each of the electrodes is imaged using a PLOM 2000 camera and a statistical analysis is used to evaluate the discharge. Using 3D printers to create electrical components allows for greater efficiency in professional applications by allowing users to create the components on spot without having to spend the time creating them by hand.

Materials and Methodology

Electrode Configuration

The DBD set-up consists of a cylindrical aluminum HV electrode encased by 0.8 mm thick Alumina. The printed electrodes are made by resting the 3D printed electrodes on the edge of the 0.8 mm thick Alumina, which forms a 0.3 mm wide discharge gap.

Materials and Methodology continued

Electrical system

Two sets of electrodes were printed with a Replicator 2 3D printer: one set consisted of electrodes of a width of 4 mm and the other set consisted of electrodes of a width of 2 mm. Each set had a high, medium, and low density printed electrode. The copper tape was inserted by passing the printer halfway through the print while carefully placing it along the half-finished electrode so that the printer could cease to make up the electrode.

Printed Electrodes

The spectrometer probe was held about 2 inches from the discharge. A 40 images at a time. A Tektronix P6105 HV voltage probe was attached to the HV electrode. The parameters that are altered in the experiment. Each of the electrodes is imaged using the PI-MAX 3 ICCD camera and a statistical analysis is used to evaluate the discharge. Using 3D printers to create electrical components allows for greater efficiency in professional applications by allowing users to create the components on spot without having to spend the time creating them by hand.

Spectroscopy

The probe was inserted in the back flange of the DBD and cooled with a copper composite. The flange itself supported the spectroprobe. The spectroprobe was fielded to a 12 inches distance from the discharge.

Imaging

A digital camera was used to image the discharge with a 5 minute time.

The camera was triggered by the oscilloscope when the scope’s signal was triggered by the discharge current.

Any electrical data obtained by the scope was oscillogram converted.

Conclusions

Electrodes with a greater density had a higher number of microdischarges forming than those with lower density for a given thickness. The low density electrodes had the greatest tendency to arc. The 2 mm and 4 mm low density were damaged after 20 seconds.

References


3D Printed Electrodes for a Dielectric Barrier Discharge

Robert Albertson1, Sophia Gershman2 and Andrew Zwicker2

1Mercer County Community College, West Windsor NJ, 08550; 2Princeton Plasma Physics Laboratory, Princeton, NJ 08543-0451

Introduction

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