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Flat Dielectric Barrier Discharge Lamp in Interaction with a Resonant Power Supply

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Introduction

Dielectric Barrier Discharge (DBD) lamps have a lot of applications in industry and research (lighting, surface treatment, etc.), so the knowledge of their behavior and their parameters are essential. A DBD lamp is generally composed of 2 dielectric layers, separated by a gas mixture [1]. Plasma will appear in the gas when the v_{gas} voltage reaches the V_{th} threshold.



The purpose of this study is to analyze the interaction between a pulsed current power supply [2] and a flat DBD lamp.

Material and methods

Dielectric thickness : 3.15mm
GAP : 2 mm
Gas : Ne-Xe 50% 400 mBar
Area : 60x60 cm

The Power Supply operates on a resonance principle

power source = fixed part of the power supply + coil to be adapted

Dielectric barrier discharge part = Characteristics to be determined

Electrical transformer = part to be adapted

Manley Diagram

AB and CD: capacitive phases **plasma off**.
The slope of AB indicates the capacity value C_{eq} .
 $C=C_{eq} = \frac{C_{diel} + C_{gaz}}{C_{diel} + C_{gaz}}$

BC and DA: discharge phases **plasma on**.
The slope of BC indicates the capacity value C_d .
 $C=C_d$

Matlab

Experimental Current

Results and discussion

20kHz to 80kHz

Series of measurements by setting the input voltage amplitude to 150V and varying the frequency from 20kHz to 80kHz

Capacity

Capacités en fonction de la fréquence imposée

Vth

PManley et Pnoy (40kHz)

PManley et Pnoy (50kHz)

Power + Luminance measurements

40kHz

45kHz

50kHz

55kHz

30 to 180V

Series of measurements by setting the frequency to 60kHz and varying the amplitude of the input voltage from 30 to 180V.

Capacity

Capacités en fonction de la tension d'entrée

Vth

n=3

n=4.5

Inductance

Conclusion and perspectives

Theoretical formulas make it possible to determine in advance the voltage, current and power amplitudes.

Maximum efficiency of 18 lum/Watts achieved.

An additional optical study will have to be carried out by modifying the inductance value.

References

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