Population Kinetics of a Repetitively-Pulsed Nanosecond Discharge

by

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I would like to dedicate this dissertation to someone else.

A C K N O W L E D G M E N T S

Who is this?

Preface

This is a dissertation about something; I really hope it's good.

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DBD dielectric-barrier discharge

CHAPTER 1

Introduction

1.1 Background

1.1.1 History of Atmospheric-Pressure Discharges

Like most physical phenomena, plasmas are typically only described under ideal circumstances. This means that neutral collisions, and subsequently, atmospheric plasmas, are often ignored. Neutral collisions tend to obscure the electromagnetic effects that distinguish a plasma from a gas. However, the history of observation and study of plasmas is indelibly linked to atmospheric plasmas. Lightning and static sparks are the most prevalent plasmas on earth. Indeed, the first artificial plasma was an atmospheric arc, the work of a Russian scientist named Vasilii Petrov.

The work of Petrov was the forerunner to the study of thermal plasmas. In 1802, Volta's recent invention of the voltaic pile provided the first source of constant electrical energy. Using a series of voltaic cells, Petrov was able to draw the first electrical arc between two sticks of carbon. Aside from its blinding light, these arcs were characterized by their significant ionization, and high degree of thermal equilibrium. Gas temperatures could reach thousands of kelvin.

In contrast, later work by Werner von Siemens, led to the discovery of the so-called "silent discharge." In recent years, the terminology has changed and this type of discharge is now referred to as a dielectric-barrier discharge, or DBD. The DBD was significantly different from the thermal arc. Visually, it was much dimmer, and appeared to be composed of many thousands of individual filaments. Additionally, the DBD did not significantly heat the air, unlike the thermal arc. Finally, the DBD was used in the first commercial plasma application: ozone generation and water purification. Notably, this predated the 'official' discover of plasma by Sir William Crookes in 1872.

At first, these two discharges were essentially scientific curiosities. Early attempts to use the thermal arc as a light source failed for lack of appropriate power sources. Likewise, despite its success in ozone generation, the DBD had few other uses. However, as time progressed, the number of applications increased. The development of a reliable electric power network meant that thermal arcs became a useful source of high intensity light (to this day they continue to be used for IMAX systems), and they have become a vital tool for industrial welding and cutting processes. The DBD continues to be used for ozone generation, but is also now employed in material processing, most notably, altering the surface properties of polymers.

1.1.2 Repetitively-Pulsed Nanosecond Discharges

1.1.3 Diagnostic Difficulties

Discuss the information that is lacking. No need to be specific, but be clear about challenges

1.1.4 Research Plan

Propose research to fill this gap

1.2 Literature Review

Specific and cited history of PNDS and related measurements.

1.3 Basic Theory

Basic theory of gaseous breakdown.