

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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CHAPTER 1

Introduction

1.1 Background

It is difficult to definitely define the discovery of plasma. The observation of plasmas has spanned the whole of human existence, from the very moment we began to gaze at the stars. Wikipedia credits Sir William Crookes with first identifying it as a new state of matter in 1872 (though Crookes credits Faraday with hypothesizing its existence as early as 1819). Curiously, the first applications of plasma preceded its discovery as a new state of matter by 15 years when Ernst Werner von Siemens described the use of a “silent discharge” in air for the preparation of ozone in the treatment of biologically contaminated water.

To this day, studies continue to explore the use of plasma to treat water, now with concern for industrial pollutants. In general, the last decade has carried a surge of research on the development and application of atmospheric-pressure plasmas. However, the formation of such plasmas has always been shrouded in a degree of mystery. Most plasma diagnostics are ill-suited for use with atmospheric-pressure discharges, usually because they are too slow, make untenable assumptions, or both. Only recently has the technology and techniques reached a point at which we can begin to understand what is really happening in these plasmas.

My work concerns the study of one such atmospheric-pressure plasma. In the literature, it goes by several names; here, I will simply refer to it as a repetitively-pulsed nanosecond discharge (rpnd). Of course, the choice of a name is only moderately useful, more important is a description. The rpnd is a plasma that exhibits exceptional uniformity and volume, with minimal gas heating.

1.2 Theory

1.3 Literature Review