

PLASMA PROPERTIES OF MICROCATHODE SUSTAINED DISCHARGES IN ARGON AT ATMOSPHERIC PRESSURE

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Abstract. Microdischarges sustained at atmospheric pressure are of growing interest because of their high electron density, reproducibility and remarkably stable operation. Extensive experimental studies of microdischarges are underway in many laboratories. Here we present results from a numerical study of the plasma properties of a microcathode sustained discharge (MCSD) in argon at atmospheric pressure. The MCSD is a part of a 3-electrode system, where a microhollow cathode discharge (MHCD) is used as an electron source to sustain a larger volume discharge. Gas heating and its influence on the plasma properties of MCSD is also included in the discussion. It was found that the gas heating affects the plasma properties in MCSD in argon at atmospheric pressure only through the rarefaction of the neutral density.

1. INTRODUCTION

Stable operation of high pressure discharges in pure gases or gas mixtures can be achieved by operating with small discharge geometries (100's of micron-sized). Because of the continuing interest in generating stable, nonthermal, DC plasmas at high gas pressures, studies of such microdischarges are underway in many laboratories. Our own studies are focused on the use of a microhollow cathode discharge (MHCD) as a plasma cathode for sustaining a larger volume discharge in a 3-electrode configuration, the so-called *microcathode sustained discharge* (MCSD) [1]. A schematic of the 3-electrode microdischarge system is shown in fig. 1. The MCSD is created in the volume between a MHCD and a third positively biased electrode, placed at a distance of about 1 cm from the MHCD.

This 3-electrode configuration combines the possibility of creating a larger plasma volume with the stable operation of the MHCD which acts as a cathode. Microcathode sustained discharges are used for high-density plasma production in a large range of discharge operating conditions. It has been found experimentally [1-3] that the main parameters controlling the plasma behaviour in the MCSD volume are the current coming from the MHCD; the voltage applied between the MHCD and the electrode A2; the gas composition and pressure, and the distance between the MHCD and A2, designated here d_{A2-A1} .

The flexibility of MCSDs, in view of operating conditions, is attractive for many discharge applications. It has been shown recently that the MCSD is an appropriate discharge configuration for the production of the $O_2(a^1\Delta_g)$ metastable state at high gas pressures ($p > 50$ Torr) [4]. The current interest in generating $O_2(a^1\Delta_g)$ is in the context of electric discharge pumping of O_2/I_2 lasers or potential biological applications. Experimental work on the production of singlet oxygen using MCSDs in a variety of operating conditions is continuing, with a growing interest towards atmospheric pressure [5]. The particular interest in producing plasmas at atmospheric pressure is

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