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The DC-excited Atmospheric Pressure Glow Discharge with Liquid Electrode

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DC-excited atmospheric pressure glow discharges in a metal pin-liquid electrode system are investigated in air, N₂, He, Ar, N₂O and CO₂. Self-organization is observed in the case of liquid anode. The observed patterns depend on the current and the conductivity of the liquid. In the different gases the acidification of the liquid is studied as well as the influence of the filling gas on the optical emission. The rotational population distribution of OH(A-X) is investigated in the context of the determination of the gas temperature.

1. Introduction

Like other atmospheric pressure non-equilibrium discharges such as corona discharges and dielectric barrier discharges, atmospheric pressure glow discharges (APGDs) have been extensively studied in recent years in view to overcome the need for expensive low pressure systems as well as for new applications [1-3]. Additionally using a liquid electrode efficient strong generation of UV radiation and active radicals can be obtained.

In this contribution the DC-excited APGD with liquid electrode is investigated in different gases such as air, N₂, He, Ar, N₂O and CO₂.

2. Results

Self-organization of the anode layer occurs when the liquid electrode is anode. In the case of air the anode spot structure evolves from a constricted homogeneous spot to a pattern consisting of small distinct spots with increasing current in the range 5 to 30 mA. The coexisting spots group together and form stripe patterns or rings [4].

In nitrogen containing gases (air, N₂ and N₂O) as well as in CO₂ the acidity of the liquid increases after plasma treatment, which is caused by the formation of HNO₂, HNO₃ and H₂CO₃ [5]. In Ar the pH remains constant after treatment.

As is already known, the rotational temperature obtained from OH(A-X) does not always provide a good estimate of the gas temperature in the case of liquid plasmas [1, 6]. The measured rotational temperature of OH(A-X) is higher than the rotational temperature obtained from N₂(C-B) and is significantly lower in atomic gases than in molecular gases. In all gases a deviation from a Boltzmann rotational population distribution of OH(A) is observed due to the formation process of OH(A). This non-Boltzmann behavior is more pronounced in the case of He. The measurements

suggest that vibrational energy transfer could explain the non-Boltzmann distribution of OH(A). The importance of recombination processes in the production of excited species will be discussed [7].

3. Conclusion

Self-organization is observed when the liquid electrode is anode. When the discharge gas contains nitrogen or CO₂, acidification of the liquid occurs. Deviation from a Boltzmann rotational population distribution is observed in all gases due to the formation process of OH(A) and deviating temperatures are found compared to other molecular bands.

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