

Argon emission spectra change at molecular gas addition

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The aim of this paper is to present the modification of the emission spectral lines of Ar at the addition of various amount of N₂. Because the post luminescence discharge contains atoms and molecules in excited states at gas pressures between 10-100 torr and the temperature of the flowing after glow plasma is low, we expect to have specific radiation of the excited atoms and molecules as we reported before for electropositive- (noble gas) and electronegative (H₂) gas mixtures. Preliminary results sustain our expectation, the recombination plasmas, enhancing the intensity of some peculiar lines of the gases as in the case of M-effect when the gas mixture is Ar+N₂. The obtained data add new results sustaining our hypothesis of ion-ion recombination in the electronegative-electropositive gas mixtures generating M-effect.

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1. Introduction

Investigation of the changes in the optical emission spectra of DBD in certain gases at addition of hydrogen, oxygen or chlorine is an old research subject of our group [1-4]. The phenomena of the selective emission of very few lines (or, in some cases, the spectra is reduced to only one line emission) in electropositive and electronegative gas mixtures was called 'Monochromatization effect' (M effect)

The influences of controlled addition of hydrogen in DBD discharge of Ne, Ar, Kr and Xe, respectively, were also investigated experimentally by optical emission spectroscopy [5-7].

This paper presents the change of the argon spectra at molecular gas addition, N₂ for instance. The obtained results sustain our expectation to obtain specific spectra of recombination plasmas, enhancing the intensity of some peculiar lines of the gases as in the case of M-effect. The obtained data add new results sustaining our hypothesis of ion-ion recombination in the peculiar case of argon-nitrogen gas mixtures, generating M-effect in optical emission spectra of two interacting plasma jet (flowing glow plasmas).

2. Experimental arrangement

Experimental set up consists from a pyrex glass envelope with a diameter of 200 mm and a length of 300 mm Pyrex glass tube and two plasma guns in order to produce the plasma jets. The emission spectra were performed with an Ocean Optics spectrometer with a 2048 CCD detector and a spectrometer's grating of 600 groves/mm, between 200 nm and 850 nm.

Two different gas beams: Ar and N₂ are introduced inside of this vessel, continuously pumped by a Roots-mechanical pump system.

2.1 Interacting plasma jets

Experimental set up for interacting plasmas is shown schematically in Fig. 1. The photo image of plasma jets and their configurations to each other are represented in Fig. 2.

Inside of the vacuum vessel are mounted two flowing plasma jets. One of the plasma jet (Ar) has an axial position in the vacuum vessel. The second plasma jet (N₂) has a perpendicular position against first plasma jet generator (see Fig. 1).

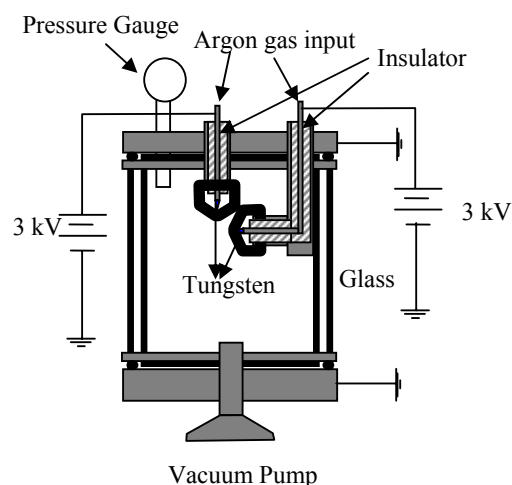


Fig. 1. Schematic view of the interacting Plasma Jets System.



Fig. 2. The photo image of the interacting plasma jets.

2.2 Flowing after glow plasma

A molecular gas (N_2) was added to Ar plasma flowing in after glow discharge system. Digital photo image of the flowing afterglow discharge and the experimental set-up for recording the emission spectra are shown in Fig. 3.

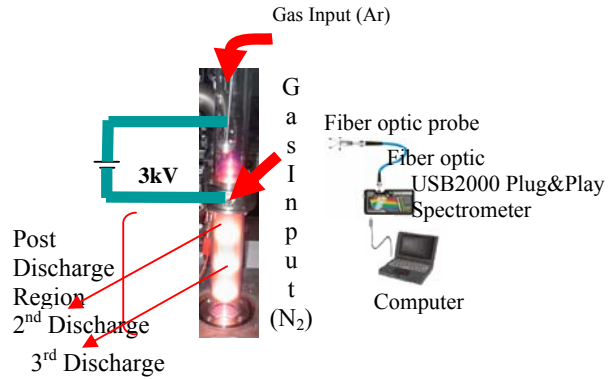


Fig. 3. Photo image of the flowing N_2 in Ar afterglow discharge.

3. Preliminary Experimental Results

3.1 Experimental results of the interacting plasma jets

Fig. 4 represents the optical emission spectra using Oceanoptics USB 2000 spectrometer (a) and the photo image of the Ar plasma jets (b). The emission spectra reveals only the typical Ar emission spectra lines.

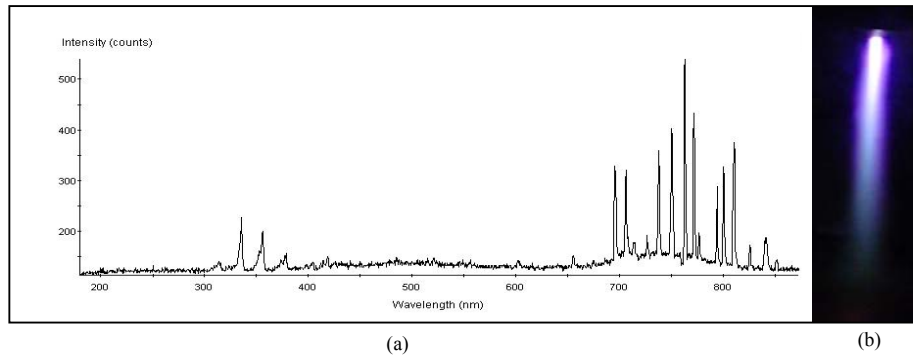


Fig. 4. a) Optical emissions spectra of Ar plasma jet and b) Photo image of the Ar plasma jet.

Fig. 5a represents the optical emission spectra obtained by using Oceanoptics USB 2000 spectrometer (left) and the photo image of the Ar+Cu plasma jets. It can

be clearly seen the Ar spectra but in addition, we can also identify the specific Cu emission spectra lines due to the Cu electrodes holder.

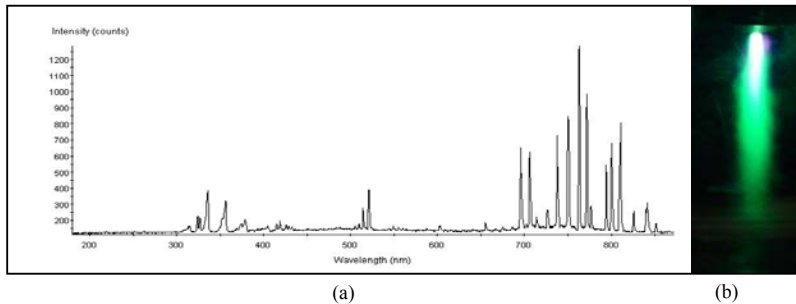


Fig. 5. a) Optical emissions spectra of Ar+Cu plasma jet and b) Photo image of the Ar+Cu plasma jet.

3.2 Experimental results of the flowing afterglow plasma

In this experimental device, we can add different gaseous to the main discharge. For this research, we add N_2 into Ar plasma discharge. The initial pressure before the ignition of the ar discharge was about 10 Torr and the distance between the electrodes was maintained at the value of 80 mm. It is important to underline that the grounded electrode had a small hole with a 2 mm diameter. Produced Ar+ N_2 plasma was flowed the post discharge region, divided in three regions. The next figures represent the optical emission spectra Ar+ N_2 mixing plasma at post discharge region, recorded in the first region (Fig. 6) and in the second post discharge region (Fig. 7).

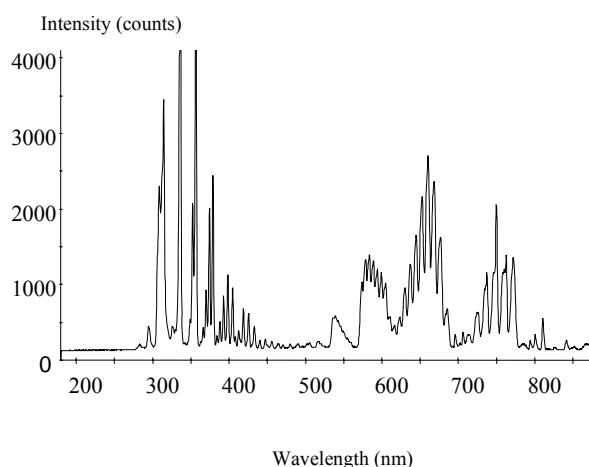


Fig. 6. Spectra of the Argon plasma and nitrogen plasma.

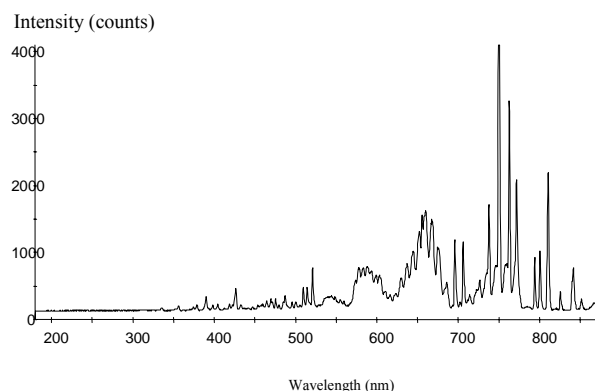


Fig. 7. Spectra of the Argon plasma and nitrogen plasma.

There are an obvious dominance of the band spectra of nitrogen (between 300-400 nm) in the first discharge region (Fig. 6) comparative with the second discharge region (Fig. 7). There are also a spectacular increase in the band of argon in the range of 700 nm-800 nm, while the

other bands of Argon decreased significantly. These phenomena can be explained only taking into account the ion-ion recombination in the electronegative-electropositive gas mixtures, according to the M-effect.

4. Conclusion

Inside of the glass tubing are arranged two gas flow jets with perpendicular directions. The emitted spectra of separate and interacting jets are taken using Optical Multichannel Analyzers. Preliminary results sustain our expectancy to obtain specific spectra of recombination plasmas, enhancing the intensity of some peculiar lines of the gases as in the case of M-effect. The obtained data add new results sustaining our hypothesis of ion-ion recombination in the electronegative-electropositive gas mixtures as generating M-effect.

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