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SPECTROSCOPIC CHARACTERIZATION OF LOW PRESSURE ARGON DISCHARGE CREATED BY INDUCTIVELY COUPLED PLASMA SOURCE

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ABSTRACT: In this report, we are interested in large area reactor plasma created by Inductively Coupled Plasma (ICP) source. We present results of spectroscopic characterization at low pressure argon discharge in large area reactor created by ICP source. We’ve particularly followed the evolution of ionic argon line intensity 514.5 nm which is the second most intense line of ionic argon, versus power and pressure.

KEYWORDS: OES, ICP, Ar plasma, large area reactor

1. Introduction

There are a large number of diagnostic methods for determining the main plasma parameters, such as the density of charged particles and the electron temperature [1-3]. Among these methods there is the Optical Emission Spectroscopy (OES). This technique is widely used in plasma diagnostics for understanding the role of stable and unstable species created in an electrical discharge. For this purpose, we followed the evolution of ionic argon line intensity (514.5 nm) which is the second most intense line of ionic argon, depending on power and pressure.

2. Experimental set-up

The experimental device shown in figure 1 consists on a spherical chamber of 93 cm diameter for several accesses (18 accesses). The chamber is connected to a pumping unit designed to evacuate air until a vacuum of 10^{-6} mbar. The pumping unit consists on a primary pump which allows us to achieve a primary vacuum of about 10^{-3} mbar and a secondary pump of oil diffusion in order to achieve a high vacuum of the order 10^{-6} mbar. Pure argon gas is introduced in a flow range between 0 and 20 sccm. Working pressure varies from $2\ 10^{-2}$ to $1.3\ 10^{-1}$ mbar. To create the plasma, we used an inductive excitation system. This system consists on a Pyrex tube surrounded by a copper coil polarized by an RF generator (13.56 MHz). The input power varies from 0 to 320 W. The spectroscopic measurements were made by a spectrometer (Jobin-Yvon THR 1000) powered by supply voltage and linked to the reactor via an optical fibre, see figure 1.

3. Experimental results and discussions

3.1. Effect of the power upon intensity of 514.5 nm argon line

On figure 2, we present the influence of ionic argon line intensity depending on the power for more pressure values. The result shown that, the ionic argon line intensity increases with input power and seems at power higher than 300W, reaching saturation.

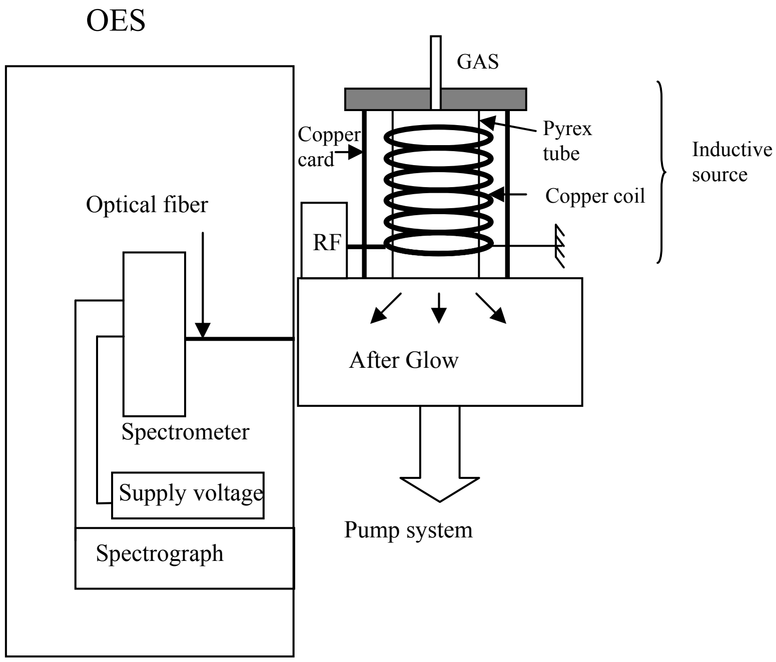

Figure 1: Experimental set-up.

That behaviour of line argon intensity is physically explained by an increase of electronic energy and density with the power [5-7], and the transition from the capacitive mode to inductive mode which increases species of argon ionic within our discharge [2, 3].

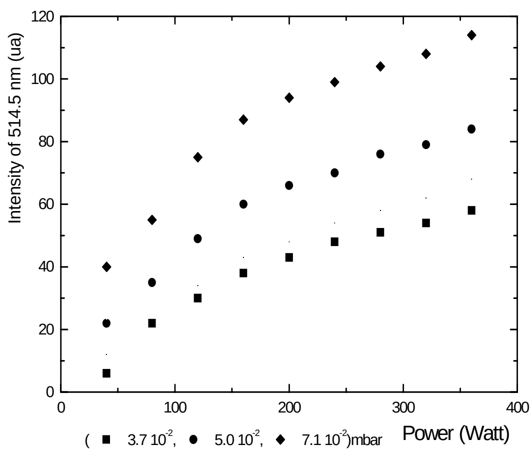

Figure 2: Influence of the power upon intensity of ionic argon line.

3.2. Effect of the pressure upon intensity of 514.5 nm argon line

On figure 3, we present the variation of ionic argon line intensity depending on the pressure for different power values. There is an increase of ionic argon line intensity versus the pressure. That behaviour is physically explained by the decrease in mean free path with the pressure increasing, consequently, the collisions between particles increases, which increase the ionic species and the transition from E mode to H mode which increases species of argon ionic within our discharge [2, 3].

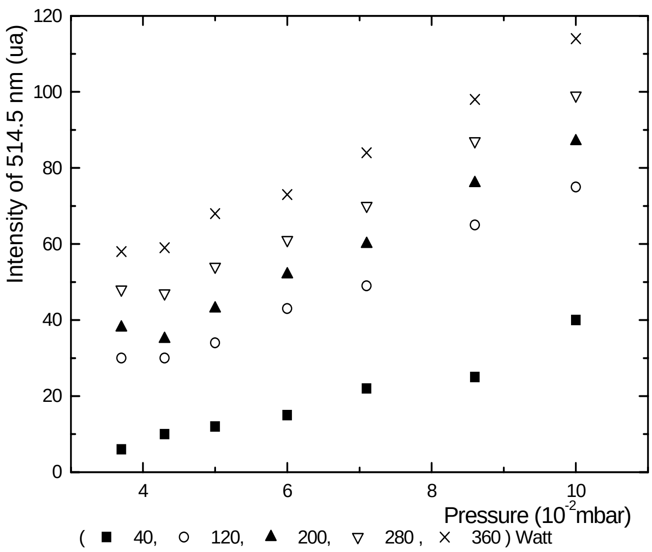

Figure 3: Influence of the pressure upon intensity of ionic argon line.

4. Conclusion

The study presented in this work is the effect of pressure and power on ionic argon line intensity in a plasma large area reactor inductively excited by RF (13.56 MHz) source. We used in our characterisation the optical emission spectroscopy (OES) to optimize operating points of our reactor. This allowed us to see that the ionic argon line intensity increases with power and pressure. These results let us interesting in mode transition in this kind of plasma to optimize operational parameters in surface treatments applications.

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