

Marcondes A.R.^{1*}, Ueda M.², Bergtamo E.C.³^{1,2,3}*Laboratório Associado de Plasma, Instituto Nacional de Pesquisas Espaciais*

1. Introduction

Langmuir probe is one of the simplest ways to measure plasma parameters. Basically, it consists of a thin wire that is inserted into the plasma. Once in contact with the plasma, the current in the wire is measured at different applied voltages. Based on current and voltage measurements, the I x V characteristic curve is obtained and the plasma parameters may be calculated from the coordinates and slopes from the curve. Plasma immersion ion implantation (PIII) is a relatively novel plasma treatment used at INPE to modify the surface of different types of materials. In our laboratory, the most common source of plasma is the DC glow discharge. In this discharge, there is a fixed cathode and a fixed anode. Electrons are accelerated from the cathode to the anode acquiring more and more energy during their pathway. Collisions among electrons and ions and neutral particles occur and provide more ionized particles and electrons as the free electrons can transfer energy to bonded electrons during the collisions. If the electric field strength is high enough, the energy transfer can reach a certain level and an avalanche breakdown will happen in the gas inside the chamber. The avalanche breakdown multiplies de electrons and ions inside the chamber leading to a gas full of positive, negative ions and electrons. This state is called plasma where there is an assemblage of free positively and negatively charged particles and neutrals, and the negative and positive charges nearly balance each other at the macroscopic level. The plasma is usually characterized by the ions and electron densities and ions and electron energies or temperature. Other important parameters to be known are the plasma potential and the floating potential, that is respectively, the plasma potential relative to the walls of the chamber and the potential developed at a surface in contact with a plasma when electrically isolated from the ground.

2. Experimental

In this work, the Langmuir probe from *Impedans Ltd* was used to perform the diagnostic of a DC glow discharge formed in the 3IP-CE treatment system at INPE. The plasma conditions were those usually used during the PIII treatments. The DC Voltage was 300 V and the current was 2.0 A. The gas used was Nitrogen with a working pressure of 4.3×10^{-3} mbar. The plasma diagnostics were performed using simple and double probes.

3. Results and Discussions

Diagnostic using simple probe has shown no good results as the plasma potential is relatively high due to the high DC voltage applied by the DC power supply. The diagnostic using double probe has shown better results. In this case, it was possible to determine some plasma parameters. Preliminary measurements have indicated that the glow discharge operating in the conditions above presents an electron temperature of around 12 eV, an ion density of 1.6×10^{-9} cm⁻³ and a current density of 1.2 A/m². The setup of the new *Impedans* Langmuir probe is still going on and much work needs to be done to adapt de probe to the other PIII treatment systems of our laboratory.