Using biased hairpin probe for determining oxygen negative Ions in a double plasma device

A K Pandey[a, b], S K Karkari[a, b]

[a]*Institute for Plasma Research, Bhat, Gandhinagar, Gujarat, India 382428*

[b]*Homi Bhabha National Institute, Training School Complex, Anushakti Nagar, Mumbai – 400094*

The hairpin probe is a quarter-wave transmission line. The probe exhibits a resonance which is determined by the dielectric constant of the medium surrounding the hairpin. When immersed in the plasma, the observed resonance relates to the electron plasma frequency through the plasma dielectric constant. Hence the electron density, n_e, can be directly found using this technique. The hairpin probe had been used as a detection probe in pulse laser photo-detachment of negative ions. In this paper we demonstrate that the hairpin probe can also act as a Langmuir probe to determine α (ratio of negative ion density and electron density). It is observed that on applying positive bias to the hairpin, the resonance frequency shifts towards higher values, reaching saturation at the plasma potential. The positive ion density is determined from the ion saturation region, based on OML theory. It has been found that the OML theory is suitable for calculating the positive ion density, showing excellent match with the electron density obtained by hairpin resonance in electro-positive argon plasma. Using this method, the value of α has been determined in oxygen discharge in a double plasma device. Experimental results show a decreasing trend in α on increasing the power levels, consistent with the previous results.

Reference:

[1] Stenzel R L 1976 Rev. Sci. Instrum. 47 603.

[2] A. K. Pandey and S. K. Karkari, Phys. Plasmas **24**, 013507 (2017).