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Spatial Control of Plasma Parameters in a Double Plasma Device by Selective Biasing of a Mesh Separator

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A prototype double plasma device with a multifilamentary plasma source have been configured for controlling plasma parameters, especially electron temperature in the target region by selective filtering of source plasma diffusing into it. The filtering was realized by properly biasing a separation grid placed between source and target chamber. The role of floating grid, biased grid, grid's geometrical as well as effective transparency in controlling plasma parameters had been investigated after optimizing the double plasma device configuration. By biasing the grids (transparency~ 45% and 75%) between -25 V to 0 V, electrons were cooled down from 5.1 eV to 3.3 eV and heated up from 4.8 eV to 7.3 eV for applied bias of 0 to 20 V. The transparency is further varied by realizing Debye sheath thickness variation across grids. It was observed that heating or cooling of plasma is most effective when the ratio of source to target density is maximum. Apart from controlling the electron temperature, plasma potential in the target plasma was changed from -5 V to +25 V and plasma density from 1.2×10^{15} to 8.5×10^{15} m^{-3} for the similar range of grid bias. Comparison of electron energy distribution function obtained for source and target plasma clearly indicates that the filtering effect of grid by seeing suppression of energetic electrons during the cooling and rise of energetic tail during the heating process. This mechanism of single point control of plasma parameters has been further extended to radial control of plasma parameters by charging separately the grids of segmented concentric multiple grid arrangement, covering the whole cross-section of plasma. It has demonstrated not only variation in gradient scale length of density and potential is realized but also a radial control on electron temperature with gradient scale length of less than 10 cm in unmagnetized plasma has been successfully demonstrated.

References

[1].R. J. Taylor, D. R. Baker, and H. Ikezi, Phys. Rev.Letts., 24, 5 (1970).
[2].R. J. Taylor, K. R. MacKenzie, and H. Ikezi, Review of Scientific Instruments 43, 1675 (1972).
[3].A. Y. Wong, B. H. Quon, and B. H. Ripin, Phys. Rev.Letts., 30, 26 (1973).
[4]. Prince Alex, A. K. Sanyasi, Prabhakar Srivastav, P. K. Srivastava, R. Sugandhi, and L. M. Awasthi, Physics of Plasmas 26, 112115 (2019).
[5]. Prince Alex, A. K. Sanyasi, Prabhakar Srivastav, P. K. Srivastava, R. Sugandhi, and L. M. Awasthi, Plasma Source Science and Technology, Accepted on 12 May 2020.