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Influence of microwave driver coupling design on plasma density at testbench for Ion sources plasma studies, a 2.45 GHz electron cyclotron resonance plasma reactor

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Abstract-

A comparative study of two microwave driver systems (preliminary and optimized) for a 2.45 GHz hydrogen Electron Cyclotron Resonance plasma generator has been conducted. The influence on plasma behavior and parameters of stationary electric field distribution in vacuum, i.e., just before breakdown, along all the microwave excitation system is analyzed. 3D simulations of resonant stationary electric field distributions, 2D simulations of external magnetic field mapping, experimental measurements of incoming and reflected power, and electron temperature and density along the plasma chamber axis have been carried out. By using these tools, an optimized set of plasma chamber and microwave coupler has been designed paying special attention to the optimization of stationary electric field value in the center of the plasma chamber. This system shows a strong stability on plasma behavior allowing a wider range of operational parameters and even sustaining low density plasma formation without external magnetic field. In addition, the optimized system shows the capability to produce values of plasma density four times higher than the preliminary as a consequence of a deeper penetration of the magnetic resonance surface in relative high electric field zone by keeping plasma stability. The increment of the amount of resonance surface embedded in the plasma under high electric field is suggested as a key factor.

Index Terms-

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