Design of Dual Frequency Sub-atmosperic Microwave Plasma Device

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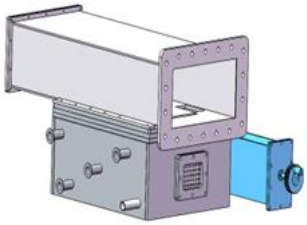

Microwave-induced large-area and uniform plasmas (MILAUP) have been getting attention in industry and lab research for their advantages like higher electron density, stronger activeness, larger procesing area, and so on. Compared with atmospheric pressure microwave plasma, low-pressure microwave plasma has a larger area of excitation and a more stable discharge. The dual-frequency feed method is adopted to make up for the deficiency of single-frequency feed in plasma uniformity. And the two feed-sources are fed vertically to each other to reduce coupling interference, at the same time, the slit is made along the propagation direction of the waveguide electromagnetic wave, and the electromagnetic wave fed into the reaction cavity is more uniform, so that the generated plasma is more uniform. this paper proposes to design a multi-mode cavity with dual frequencies to obtain more uniform electric field intensity distribution and consequently get large uniform plasma. The powers at these two frequencies (2450MHz and 915MHz) are fed perpendicularly into the cavity, to minimize the power coupling between these two feeds. To get more uniform electric field distribution, the microwave energy is coupled into the cavity by various slots along the length of the cavity. The Finite Element Method (FEM) is used to optimize the sizes and positions of the slots and cavity dimensions. Simulation results show that the uniformity of the electric field distribution inside the cavity is much more improved with dual frequencies, as shown in Figure 1. With the input powers of 1W respectively at 2450 MHz and 915 MHz, the electric field intensity achieves 2.5x10^3V/m, which empowers the cavity the potential to trigger argon and generate large uniform plasma with a hundred watts of microwave power. High field strength is generated inside the reaction chamber, and the working medium gas is broken down for gas discharge. The ionized gas forms a plasma beam, which fills the whole space and covers the large surface of the material to be treated, so as to achieve the purpose of treatment.