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Conceptual design, manufacturing and investigation of dipole plasma antenna with the capability of frequency variation in the VHF band

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Abstract

In this article, we simulate and manufacture a dipole plasma antenna whose frequency is variable in the VHF band. The conductive medium of antenna is the plasma created by the DC discharge in a glass tube. To excite the antenna, we use a cylindrical aluminum coupler installed at the middle of the antenna. By varying the values of gas pressure, the input impedance of circuit and the voltage deference between the two ends of the plasma medium, one can change the working area of the antenna at a few hundred gigahertz frequency interval. Simulation and numerical calculations are carried out for an antenna with 78 cm length and 2 cm radius at 0.8 bar pressure, as exerted under 15 KV voltage difference. At constant pressure, by using some parallel resistors in the antenna circuit, the impedance of the discharge circuit is changed and consequently, the plasma density is varied. For plasma frequencies, $\omega_p = 8\times10^8\ Hz$ and $\omega_p = 9.5\times10^8\ Hz$, using semi-experimental formulae shows the resonances at frequencies 250 MHz and 311 MHz, respectively, which are in good agreement with the experimental results taking place at frequencies 217 MHz and 272 MHz. Additionally, simulation is accomplished for a metal antenna with the corresponding geometry whose working frequency is detected at 184 MHz.

Keywords: plasma antenna, plasma, plasma frequency, dipole antenna, plasma antenna simulation, CST

For full article, refer to the Persian section