
Simulation of Radiation Pattern of a Reconfigurable Plasma Antenna

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Abstract

This paper is aimed at the investigation of reconfigurable plasma antenna parameters. Single plasma antenna is designed and its antenna parameters are studied. The single plasma antenna can be transformed into array of small antenna elements, which are called an array plasma antenna. Both type of antenna are excited on single end by surface wave. Antenna parameters such as radiation pattern, AGP, directivity etc of the single and array plasma antennas are studied with the help of High Frequency Structure Simulator (HFSS) Ansoft 0.7 version. Situation results are compared with the experimentally obtained results. This study reveals that the array plasma antenna is more directive than single plasma antenna.

I. INTRODUCTION

In recent past, a number of spin-off plasma based electronic devices such as plasma-mirror, plasma phase shifters, plasma switches, plasma photonic crystals, plasma window, plasma waveguides, plasma antenna etc. However the concept of these devices was proposed long back in seventies [1,2], which is now well-accepted by both the scientist and engineering communities. Among many of plasma devices, plasma antenna technology has inspired a great interest due to its potential advantages over conventional antennas and provides basic information to develop new electronic devices [3-5]. In last few years, It has been demonstrated that plasma antenna can be efficient and generate low noise so as to be useful for narrow band high frequency and very high frequency communication [6,7]. Therefore it can provide an integral and most important part in both communication and plasma stealth technology. Due to great applications, number of remarkable findings have been patented and several industries and organizations have expressed their interest in the plasma antenna technology to their product and service such as Hakleka, Plasma antenna Ltd, Markland Technology, CEA technology Moterola etc. Apart from laboratory plasmas, antenna properties of other plasma have also been studied such as those present in the earth's ionosphere. With growing importance and applications of plasma antenna, theoretical and experimental studies have carried out in the last few decades [8].

Most of studies were focused on experiments on single plasma antenna to find out physical properties and antenna noise source due to plasma noise however simulation of single plasma antenna with the help of numerical and computational codes has been performed [9]. To enhance the application of plasma antenna, different configuration of glass tubes or discharge tube have been constructed and studied as plasma reflectors and plasma window [10]. Recently it is found that plasma structure can be transformed into different geometries [11, 12]. Experimental attempts have been made to demonstrate that the different plasma structures can be used in wireless communication [13].

This study devotes our attention on simulation of radiation pattern of reconfigurable plasma antenna and results are matched with experiments. The paper is composed as, section II gives design of single plasma antenna, section III deals with simulation of single plasma antenna, section IV provides design of array plasma antenna, section VI presents the simulation results of array plasma antenna, section VI gives the comparison between single and array plasma antenna and at the end section VII is the conclusions of the study.

II. DESIGN OF SINGLE PLASMA ANTENNA

A design of experimental set-up of plasma antenna is shown in Fig.1. In this et-up, a 30 cm long glass tube with diameter of 3 cm is evacuated by a combined system of rotary and diffusion pumps. The system is than filled with argon gas to various working pressure. A capacitive coupler with width of 35 mm is mounted 2