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# Computer Aided Modeling of a New Microwave Plasma Cavity with the H-type Excitation at Microwave Frequency

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**ABSTRACT**

Computer modeling of the semi-lumped H field-generating multi helical coil, which can be used for generation of H-type discharges at microwave frequencies is presented in this paper. The aim of modeling was to support the design of model plasma source based upon a set of realistic dimensions, which should enable excitation of maximal values of H field at the axis of the discharge tube. As a result, a Microwave-Driven Inductively Coupled Plasma cavity (MICP) has been constructed and its assembly is presented in this paper. The new cavity can be applied in the emission and mass spectroscopy but also can find another applications where maximum H-type coupling is essential.

**KEYWORDS**: Inductively coupled plasma (ICP), microwave plasma head, plasma cavities, plasma spectroscopy.

## INTRODUCTION

Among different methods of plasma generation, microwave method is a promising low background and high excitation temperatures as well as able of working with molecular and atomic gases. The well known microwave plasma cavities such as Microwave Plasma Torch (MPT) or $TM_{010}$-mode Beenakker and TEM mode cavity have been discussed by Jankowski et al. [2010] together with several new designs including the new rotating field discharges as well as presenting some preliminary studies in the new H-type microwave discharges. Inductively Coupled Plasma (ICP) is widely known as that generated in the H-type discharge which is energized with the use few turn inductors supplied from high power RF oscillator [Boumans, 1987]. Advantage of ICP is its immunity to sample loading which results from the skin-like distribution of H field-induced currents. At microwave frequencies the dimensions of a single turn made around the practically sized 10 mm outer diameter tube are too large to enable axially symmetrical H field to be excited in the plasma tube. This is because the total length of inductor wire even if in a single turn is too long to enable the creation of lumped inductance. The idea suggested by Jankowski et al. [2008] has brought a solution to this problem by introducing symmetrically distributed plurality of partial turns instead of full turns. This way the electric phases in each partial turn can be made the same which results in generation of axially symmetrical magnetic field inside the discharge tube and generation the ICP-like plasma at