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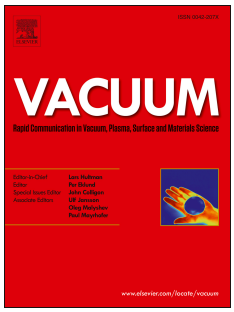

Simulation and experimental research on the parameter distribution of low-pressure Ar/O_2 inductivly coupled plasma

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Simulation and experimental research on the parameter distribution of low-pressure Ar/O_2 inductivly coupled plasma

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Abstract：Adding electronegative gas to the inert gas is an important means of adjusting the plasma parameter distribution. In this paper, a fluid model of the Ar/O_2 inductivly coupled plasma (ICP) is used to investigate the parameter distribution, while the electron energy distribution function (EEDF) and the transport coefficients are obtained by the Boltzmann equation solver module to improve the accuracy. The spatial-temporal evolution of the electron density and the electron temperature of the ICP are obtained and the influence of the discharge power and the oxygen mole ratio on the distribution of the ICP parameters is compared. Additionally, the physical mechanism is researched using the diffusion-transport theory of the plasma. In order to verify the reliability of the model results, an experiment is carried out to diagnose the discharge parameters. The results of the simulation and the experiment are performed for different power and oxygen mole ratios and a good qualitative and numerical agreement is obtained, indicating that the inclusion of the simulation results in a high accuracy.

Keywords：Ar/O2 inductively coupled plasma; Fluid model; Boltzmann equation module; parameter distribution

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1. Introduction

Inductivly coupled plasma (ICP) is a stable and uniform high-density plasma source with low radio-frequency (RF) power and discharge pressure [1], a simple device structure, and parameters that are easy to adjust [2]. Thus, ICP has a great potential application in reducing the electromagnetic scattering characteristics of the inlet and radar cabin of stealth aircraft [3,4,5]. Adding electronegative gas to the inert gas is an important means of adjusting the plasma parameter distribution; therefore, the study of the discharge characteristics of the ICP at different argon-oxygen mixing ratios is of important significance [6].

For an analysis of the electromagnetic scattering properties of a target by ICP, the dielectric