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Modeling and Experimental Study of Radio-frequency Glow Discharges and Applications for Plasma Processing

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Low pressure radio-frequency glow discharges are investigated using theoretical modeling and various experimental diagnostic methods. In the calculations, global models and transformer models are developed to understand the chemical kinetics as well as the electrical properties such as the effective collision frequency, the heating mechanism and the power transferred to the plasma electrons. In addition, Boltzmann equation solver is used to compensate the effect of the electron energy distribution function (EEDF) shape in the global model, and the general expression of energy balance for non-Maxwellian electrons is developed. In the experiments, a number of traditional plasma diagnostic methods are used to compare with calculated results such as Langmuir probe, optical emission spectroscopy (OES), optical absorption spectroscopy (OAS) and two-photon absorption laser-induced fluorescence (TALIF). These theoretical and experimental methods are applied to understand several interesting phenomena in low pressure ICP discharges. The chemical and physical properties of low pressure ICP discharges are described and the applications of these methods are discussed.

Keywords: Plasma modeling, RF glow discharge