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Temperature diagnostics by optical emission spectroscopy in different gas mixture microwave discharges

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The production of atomic species by dissociation of molecular gases is carried out in microwave plasma sustained by an electromagnetic surfacewave. The plasma source operates at a frequency of 2.45 GHz modulated by a pulse sequence in the ms- range. This kind of glow discharge plasma is normally used to dissociate diatomic molecules such as N_2 or O_2. Among the other plasma parameters, the gas temperature in the discharge area, can affects the dissociative characteristics of the plasma source and thus, it is an important physical quantity to monitor, particularly when the gas mixture and pulse parameters, such as the duty ratio, are varied.
In this study we investigated the kinetic temperatures of different gas mixtures in the area of microwave discharge by means of the optical emission spectroscopy. The First Positive System of the nitrogen emission spectrum was mainly utilized for this purpose, folowing by rotational gas temperature calculations [1]. Both the average and time-resolved (using an ICCD detector) temperatures were studied.
The discharge parameters which do affect mostly the plasma temperature were found. Measured averaged kinetic temperature in the dischage typically varies from about 400 K to 700 K depending on the discharge mode. This correlates with the time-resolved temperature measurements performed under the same discharge conditions.
Finally, our results confirm the dependence of the gas kinetic temperature on the pulse parameters of a microwave discharge such as pulse duration, duty ratio, and gas mixture. The differences in the measured temperatures found in different dischrages were explained (beside the plasma reactions) involving the prevously obtained results on the nitrogen dissociation [2].
References:
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