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Spectroscopic Examination of Vibrational and Rotational Properties of NO $A^2\Sigma^+$ Metastable State from NO γ-Band Spectra in N_2-O_2 Mixture Microwave Discharge HAO TAN, ATSUSHI NEZU, HARUAKI MATSUURA, HIROSHI AKATSUKA, Tokyo Institute of Technology — The spectra are observed in our microwave discharge plasma experiments. N_2-O_2 mixture plasma is generated by using a rectangular waveguide. We measured the spectra at 0, 60, 100 and 140 mm with the discharge pressure several Torrs. From these results, we can find that both NO and N_2 molecules experience a cooling down process both on vibrational and rotational temperatures as the plasma flows to the downstream direction. And NO molecule has always a higher rotational temperature than N_2. Meanwhile, we can see that in this nonequilibrium plasma, both NO and N_2 molecules tend to get higher energy for vibrational motion than for rotational motion. We also change the gas partial pressure rate, when O_2 molar ratio of the mixture increases, the NO experiences an increasing vibrational temperature. This is because that the NO $A^2\Sigma^+$ metastable state is excited from two main paths: $N_2(A\ ^3\Sigma_u^+)+NO(X\ ^2\Pi) \rightarrow N_2(X\ ^1\Sigma_g^+)+NO(A\ ^2\Sigma^+)$, (1) $NO(X\ ^2\Pi)+e^- \rightarrow NO(A\ ^2\Sigma^+)+e^-$ (2) When O_2 or N_2 is the majority of the discharge species, reaction (2) or (1) dominates the excitation process of NO $A^2\Sigma^+$, respectively. Therefore, under our plasma conditions, vibration-vibration energy transition of the reaction (1) results in a strong vibrational relaxation of NO $A^2\Sigma^+$ state molecules when N_2 is the majority in the discharge gas. In conclusion, the admixture of N_2 gas can lead to the reduction of average vibrational temperature significantly.

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