Formation of vibrational distribution function of electronically-excited $N_2(A^3\Sigma_u^+)$ molecules in nitrogen discharge plasma

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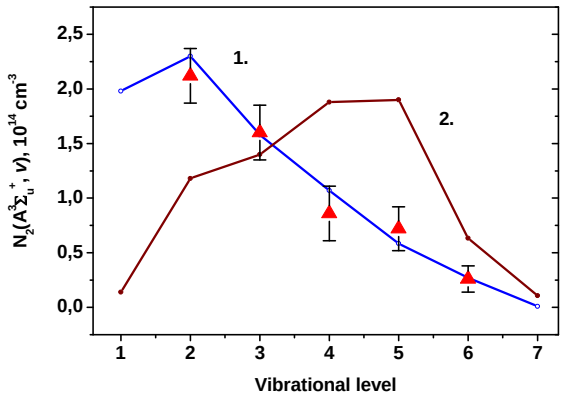
In nitrogen discharge plasma the excitation of $N_2(A^3\Sigma_u^+)$ molecules occurs mainly by deactivation of electronic states with high energies. It was assumed that the population probability of $N_2(A^3\Sigma_u^+,v)$ in the collisional quenching of $N_2(B^3\Pi_g)$ state is proportional to the Franck-Condon factors of correspondent transitions $N_2(B^3\Pi_g,v') \rightarrow N_2(A^3\Sigma_u^+,v)$, i.e. that the quenching is essentially vertical. The results of calculations carried out under this assumption are in agreement with measured data of $N_2(A^3\Sigma_u^+,v)$ vibrational distribution at the end of pulsed high current discharge in nitrogen at P = 230 Torr [1] (*Fig. 1*, curve **1**). It is also shown that the assumption about preferred population of high vibrational levels $N_2(A^3\Sigma_u^+,v \geq 6)$ in the process of collisional quenching of $N_2(B^3\Pi_g)$ is not valid since in this case the modeling results are inconsistent with the experimental data of [1] (*Fig. 1*, curve **2**).

Study of the evolution of vibrational distribution function of $N_2(A^3\Sigma_u^+,v)$ molecules in the afterglow of streamer discharge in nitrogen at high pressures have been performed for the conditions of experiments of [2] (P = 760 Torr) and [3] (P = 200 Torr). It is shown that the dynamics of $N_2(A^3\Sigma_u^+,v=0)$ number density depends essentially not only on their loss in the pooling reaction $N_2(A^3\Sigma_u^+,v) + N_2(A^3\Sigma_u^+,v) \rightarrow$ *product*, but also on additional population due to the quenching of high vibrational levels. This fact should be considered under estimation of the $[N_2(A^3\Sigma_u^+)]_0$ population at the end of discharge on the basis of the experimental measurements of $N_2(A^3\Sigma_u^+,v=0)$ losses in time.



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References

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[2] Teramoto Y., Ono R., Oda T., J. Phys. D: Appl. Phys. (2009), **42,** 235205 (7pp).
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