STUDY OF N2 VIBRATional DISTRIBUTION IN pure NITROGEN PLASMA at INTERMEDIATE PRESSUREs (10–100 TORR) using ABSORPTION SPECTROSCOPY

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Nitrogen plasma is unique in its properties, due to the fact that the binding energy of the nitrogen molecule N2 is high enough (9.79 eV). For this reason, a large amount of energy can be stored in the vibrations of the ground state N2(X, *v*) molecules. The processes of transition of vibrational energy into electronic excitation energy, and, therefore, the role of vibrational energy in the mechanisms of ionization and dissociation of N2 molecules is of great fundamental interest to this day.

The vibrational distribution of nitrogen molecules in a plasma can be studied experimentally using absorption spectroscopy. Often enough, research is carried out in a low-pressure plasma (<1 Torr), and in this case it is necessary to use a multipass resonator optical diagnostics, such as CRDS (Cavity Ring-Down Spectroscopy) [1]. In this work, as a plasma source, we used a capacitive discharge in a cylindrical quartz tube (1 cm in diameter) with symmetrical external electrodes to which an alternating voltage of 81 MHz was applied (the input power was 50–500 W). The measurements were carried out in the pressure range of 10–100 Torr. The peculiarity of this approach is that due to the increased pressure (and hence the concentration of vibrationally excited N2 molecules), it is possible to increase the absorption signal and to carry out measurements without using additional expensive mirrors. For this diagnostic, a powerful broadband source of stable radiation in the range ~250–900 nm (the so-called “white source”) XWS-65 was used [2]. As part of the fundamental study of the kinetics of nitrogen plasma, we tested the possibility of determining the concentration of the main metastable state N2(A3Σ+u), as well as vibrationally excited molecules of the ground state N2(X, *v* > 10) using absorption spectroscopy in a single pass scheme. The obtained results allow to optimize this diagnosis for further studies of the kinetics of nitrogen plasma.

This work was supported by the Russian Foundation for Basic Research (Grant No. 17-52-16001 and Grant No. 18-32-00932 \\ 18) in the framework of the project of the International Associated Laboratory of LIA LaPPA “Kinetics and physics of pulsed discharges and their afterglows” (France–Russia).

References

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