investigation of atmospheric pressure discharges with optical emission spectroscopy

Mavlyudov T.B., Shakhatov V.A.\*, and Vereshchagin K.A.\*\*

Baikov Institute of Metallurgy and Materials Science RAS, Moscow, Russia, mavludov@gmail.com,
\*Topchiev Institute of Petrochemical Synthesis RAS, Moscow, Russia,
\*\*Prokhorov General Physics Institute, Russian Academy of Sciences, Moscow, Russia

Interest in the study of physical-chemical processes in gas discharge in a molecular gas flows is connected with a number of practical and scientific problems [1,2], involves the synthesis of materials, surface modification, as well as important aspects of aerodynamics. These discharges are convenient to realize on installation setups that can provide a low-temperature plasma with an axial-symmetric distribution of parameters. In this case it is possible in full measure to apply nonperturbative methods of diagnosis. Such methods include optical emission spectroscopy.

In this of paper a comparison of spectroscopic studies of DC discharge [3] and RF torch discharge [4] in the high-speed gas flows is presented. DC discharge was ignited in the air flow (with Mach number equal to 2) oncoming on the anode (the length of the discharge gap was 40 mm, the static pressure was 200 Torr) at a current of 1 A and voltage of 2 kV. RF torch discharge was also ignited in air flow at atmospheric pressure (Mach number was equal to 1). A system consisted of quartz tube and the electrode agreed with the oscillatory circuit was used for generation the RF discharge. The signal frequency was about 13 MHz. The amplitude of applied voltage did not exceed 1 kV.

Spectrometer HR4000 was used for spectrum for registration. In both discharges the spectra were recorded from the central region of discharge perpendicular to the gas flow.

The spectral composition of the discharges was determined. The spectrums of both types of discharges are in close agreement in the wavelength range of 364 - 435 nm. This indicates similar mechanisms of the excitation and ionization. In spectrum the sequence band Δv = -2 (364 - 381nm), Δv = -3 (385 - 406 nm) and Δv = -4 (409 - 435 nm) of the second positive system of nitrogen were observed. Spectral composition of discharges defined in this work is in satisfactory agreement with the results of other authors.

For the modeling and processing of the emission spectra were used methods of unresolved rotational and partly - resolved vibrational structure of electron transitions.

In this work the distribution of nitrogen molecules over the vibrational and rotational levels and the temperature corresponding to the C3Pu state were restored. The distributions of the relative populations of the nitrogen molecule over the vibrational levels in the C3Pu state were presented. Also the role of secondary processes causing population of the vibrational levels of the C3Pu state was defined. For temperature values characterizing the distribution functions of the molecules over the vibrational-rotational levels in the excited radiative states of the nitrogen molecule was determined their hierarchy

References

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