Excitation of Guanine Molecules in Gas Phase under the Low Energy Electron Beam

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Synopsis The luminescence spectra of isolated guanine molecules in the wavelength region from 200 nm to 800 nm under the beam of slow electrons were obtained. Near 19 spectral bands and lines were observed in the spectrum. Experimentally was found that 100 eV energy electrons effectively destroy the guanine molecule with producing of atomic hydrogen.

This report presents the results of experimental study of the excitation processes of nucleic acid base guanine by electron impact. This research is a continuation of our previous studies, conducted for other nucleic acid bases - thymine and uracil [1, 2].

The experiments were carried out by an optical method that we used earlier [1]. The guanine samples (Sigma Aldrich Company, purity 99%) were in form of polycrystalline powder. The gas phase of guanine molecules was formed by heating of guanine polycrystalline powder in a separate metal container. The temperature of the container with guanine powder did not exceed 450 K. Formed gas phase of guanine proceeded by steam pipeline into cell of cubic form. A diaphragm (diameter 1.5 mm) was mounted in one of the outer edges of the cell and was used for input of the electron beam and beam source and the receiver of electron beam (a Faraday Cup) was mounted on the opposite side. Electron beam was formed by three-electrode gun with tungsten cathode. Cell was placed into magnetic field so that its field lines were parallel to the electron beam. The magnetic field was ~ $1.2 \cdot 10^{-2}$ T. To remove radiation from the cell two quartz windows were mounted on its two edges, which are parallel to the electron beam. The experiments were performed at the following conditions: current intensity of the electron beam was within the (5-6) · 10^{-5}A and $\Delta E_{½}$ ~ 0.4 eV (FWHM) energy spread; the pressure in the chamber of the cell ~ $1 \cdot 10^{-5}$ Pa.

For the first time the spectra of emission of guanine in the wavelength range of 200 – 800 nm for different energies of exciting electrons were obtained in the study. Most intensive molecular bands with maxima are at the following wavelengths: $\lambda_m\lambda_m$ = 288.5; 317.1; 326.4; 336.1; 358.3; 368.5; 385.2; 399; 416; 433.8; 486,1 nm clearly manifested in the spectra. Excitation thresholds of bands are established and their identification is performed.

References

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