## Microwave Radiation of Power Explosion in Lines within Air Windows

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In this work microwave radiation of power air explosion in lines is being considered. Microwave band is convenient for atmosphere monitoring. We will consider only that part of the range which falls into the transparency window.

Radiation emerges during transitions between rotational levels of excited molecules and molecular ions of air plasma created by neutrons and gamma radiation of the explosion. These are NO, CO, $CO_2$, $NO_2$, $O_3$, $N_2O$ molecules. The chain of reactions leading to formation of the said molecules has been considered. Since the values of dipole molecule moments are close to each other, it is sufficient to limit oneself to calculation of concentration of molecules of one type in excited medium.

To be clear formation of nitric oxide (NO) molecules has been considered. These molecules give the largest contribution to radiation within air window close to radiation wavelength of 2 mm.

We determine concentrations of molecules by solving a system of kinetic equations [1]. Source function in equations depends on time, coordinates and type of the source and is represented by a sum of following terms $\frac{e^{-t/T_i}}{T_i}\frac{e^{-r/\lambda}}{r_2\lambda}$. Here $T_i$ is ionizing radiation time constant (instantaneous, secondary and capture), $\lambda$ is radiation mean free path. When solving the system it is assumed that during time of propagation within the region of the order of gamma-ray quantum free path, radiation spectrum intensity doesn't change at $t \geq 10^{-4}\,s$ after explosion.

Probability $W_J$ of pure rotational (without change of electronic and vibrational state) spontaneous transition $J \rightarrow J-1$ has been calculated, where $J$ is quantum number of molecule total moment of momentum. Under assumption of Boltzmann distribution number $N_J$ of molecules being in state with specified $J$ has been determined.

Spectral power of nitric oxide molecules radiation has the following form: $P_\nu = \int\limits_V \frac{W_J N_J E_\nu a_\nu}{e^{h\nu/kT} - 1} dV$, where

$a_\nu = \frac{\Delta\nu}{((2\pi(\nu - \nu_o))^2 + \Delta\nu^2)^{1/2}}$ - probability of radiation at the said frequency (it is supposed that spectral line has Lorentzian shape), $\Delta\nu$ - half-width of spectral line, $E_\nu$ - quantum energy. For maximum radiation power at wavelength $\lambda = 2{,}0$ mm the following estimation has been obtained:

$$P_\nu = 1{,}0 \cdot 10^{-23} N_0^{1/2} \ W/Hz.$$

$N_0$ - total amount of gamma quanta released during explosion.

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1. Yu.B. Kotov, T.A. Semenova, V.F. Fedorov. About microwave monitoring of air plasma created by ionizing radiation source // Eng. Phys.2004, № 2, pp. 31-34. Russia.