THE STUDY OF THE KINETICS OF ELECTRONICALLY EXCITED MOLECULAR NITROGEN IN ATMOSPHERES OF PLANETS OF THE SOLAR SYSTEM

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Molecular nitrogen N2 is the main molecular gas in the atmospheres of the Earth, Titan (a moon of Saturn), Triton (a moon of Neptune) and Pluto. In the atmosphere of the Earth, the second gas in total concentration is molecular oxygen O2, in the atmospheres of the other planets it is methane CH4. The kinetics of triplet states A, B, W, B', C of molecular nitrogen in the atmospheres of Titan, Triton, and Pluto was studied during interaction with photoelectrons and during precipitation of cosmic rays into the atmosphere. The calculations took into account intramolecular and intermolecular electron energy transfer during inelastic collisions of electronically excited molecular nitrogen with N2, CH4, and CO molecules. The interaction constants of electronically excited molecular N2(A) with N2 and CO molecules were calculated using quantum-chemical approximations and showed good agreement with the available experimental data. The processes of electron excitation transfer from metastable molecular nitrogen to CO molecules in the upper atmospheres of Titan, Triton, and Pluto were considered. The interaction of electronically excited N2 molecules with methane CH4, acetylene C2H2, ethylene C2H4, and ethane C2H6 molecules in the middle atmosphere of Titan at altitudes of 50-250 km was also studied. The dominance of reactions with metastable molecular nitrogen N2(A) in the formation of radicals at these altitudes was shown for the first time. Similar kinetic calculations involving triplet electronically excited molecular nitrogen were performed for the middle atmosphere of the Earth at 30-80 km during the precipitation of high-energy relativistic electrons into the atmosphere. The constants of interaction of metastable molecular nitrogen N2(A) with oxygen molecules O2 were calculated and compared with the available experimental data. The intensities of the bands of the first and second positive systems of N2 during the precipitation of high-energy electrons were calculated. It is shown that there is a significant decrease in the intensity of the glow of the bands of the first positive system with decreasing altitude due to the influence of collisional processes on the populations of the vibrational levels of the N2(B) molecule. The influence of intermolecular processes of energy transfer from N2(A) on the formation of singlet oxygen and the glow of the Atmospheric and Infrared atmospheric bands of O2 at altitudes of the middle atmosphere of the Earth is studied.