MODELING OF INFRARED GLOW OF NITROGEN OXIDE NO IN THE MIDDLE ATMOSPHERE OF THE EARTH DURING PRECIPITATION OF HIGH-ENERGY PARTICLES

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Precipitation of high-energy particles causes an increase in odd nitrogen NOx and odd hydrogen HOx at altitudes of the high-latitude atmosphere due to a cascade of dissociation, ionization and recombination processes. The mechanisms of formation of vibrationally excited molecules NO and N2 at altitudes of the middle atmosphere of the Earth during precipitation of high-energy electrons are considered. Calculations are made for altitudes of 20-100 km. The main results of these calculations are as follows. 1. Modeling of vibrational populations of N2(X,v=2-30) during precipitation of high-energy electrons at altitudes of the middle atmosphere showed the contribution of various mechanisms of formation of vibrationally excited nitrogen molecules N2(X,v¿0). Excitation by secondary electrons is the main one for all vibrational levels v=1-10 of the ground state of the molecule. It was also found that the intramolecular process of electron energy transfer in collisions of N2(A,v=0-5)+N2 dominates in vibrational excitation of high vibrational levels v=20-30 of the ground state. 2. The study of the vibrational populations of NO(X,v=1-20) during particle precipitation at altitudes of the middle atmosphere showed that the chemical reaction of metastable atomic nitrogen N(2D) with molecular oxygen O2 is the main mechanism for the formation of vibrationally excited molecules of nitric oxide NO(X,v¿0) and the emission of 5.3 Î¼m and 2.7 Î¼m infrared bands of NO at altitudes of energy loss of precipitating electrons. It is shown that the relative contribution of the VV' process can be significantly increased and is comparable with the contribution of the chemical process in cases where the concentrations of nitric oxide [NO] increase to values on the order of the concentrations of molecular nitrogen [N2] in the atmospheric gas mixture.