Formation and Dissociation of N_3 in Icy N_2 with Far-ultraviolet Light

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Abstract

During photoexcitation of icy N_2 at 121.6 nm from a synchrotron source, emission lines in the vibronic progression of the Vegard–Kaplan system, A $^3\sum_u^+ \rightarrow$ X $^1\sum_g^+$, for N2 were concurrently observed in the wavelength range 210 – 430 nm; emission lines of N (^{2}P → ^{2}D) and N (^{2}D → ^{4}S) were recorded in the wavelength range 460–1100 nm. After irradiation of icy N_2 at 121.6 nm, the characteristic infrared absorption lines of N_3 radical in vibrational mode ν_3 appeared at 1652.6 and 1657.8 cm^{-1}. When the irradiated icy sample containing N_3 radical was subsequently subjected to photolysis at 190 nm, only emission from N (^{2}D → ^{4}S) was concurrently recorded; the IR absorption lines of N_3 vanished. The result indicates that N_3 radical in icy N_2 can be dissociated into the N (^{2}D) atom and N_2 (X $^1\sum_g^+$) molecule with light at 190 nm. Our work thus has ramifications for nitrogen transformation in cold astrophysical environments.

Keywords **- astrochemistry – ISM: molecules – methods: laboratory: solid state – molecular processes – ultraviolet: ISM.**