SUBMILLIMETER-WAVE OBSERVATIONS OF C_3N^- IN AN EXTENDED NEGATIVE GLOW DISCHARGE

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Extended negative glow and hollow anode discharges are found to be good sources of negative ions, such as CN^-, C_2H^-, and C_4H^-, for observations of pure rotational lines in the submillimeter-wave region[a]. Thaddeus *et al.*[b] detected C_3N^- in a glow discharge in HC_3N diluted in Ar buffer gas, and its rotational lines up to 378 GHz ($J = 39 - 38$) were measured. In the present investigation, this anion has been observed in an extended negative glow discharge in a gas mixture of C_2N_2 ($\sim$ 2 mTorr) and C_2H_2 ($\sim$ 3 mTorr) in Ar buffer gas of $\sim$ 15 mTorr at the cell wall temperature of 230 K. The optimum discharge current was 2-4 mA with 250 Gauss longitudinal magnetic field. The rotational lines of up to $J = 51 - 50$ in the 495 GHz region have been measured, and the improved rotational and centrifugal distortion constants are obtained.

In the discharge optimum for production of C_3N^-, neither CN nor C_3N was detected with a similar signal accumulation time used for observations of the anion. However, this reaction has been found to be an excellent source for HC_3N, and the dominant formation mechanism of C_3N^- is likely to be the dissociative electron attachment to HC_3N[c]. The radiative association of C_3N with electrons seems to be unlikely at least for the extended negative glow discharge. Apparently HC_3N is synthesized by a fast neutral and neutral reaction[d], $C_2H_2 + CN \rightarrow HC_3N + H$.

It is interesting to see that an isomer, HCCNC, is also detected in the discharge, although the number density of this species is found to be about two orders of magnitude smaller than that of HC_3N. Another isomer, HNCCC, has also been observed with much weaker signal intensity. This species might have been produced by the dissociative recombination reaction of HC_3NH^+ with electrons, although the detection of this cation has not been successful in this type of discharge.

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[b] P. Thaddeus *et al.*,*Astrophys. J.*, **677**,1132-1139 (2008)

[c] K. Graupner *et al.*, *New J. Phys.*, **8**,117 (2006)

[d] I. R. Sims *et al.*,*Chem. Phys. Lett.*, **211**, 461-468(1992); D. E. Woon and E. Herbst,*Astrophys. J.*, **477**, 204-208(1997)