Extended negative glow and hollow anode discharges are found to be good sources of negative ions, such as CN⁻, C₂H⁻, and C₄H⁻, for observations of pure rotational lines in the submillimeter-wave region. Thaddeus et al. detected C₃N⁻ in a glow discharge in HC₃N 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 C₃N (2 mTorr) and C₂H (3 mTorr) in Ar buffer gas of ~ 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 C₃N⁻, neither CN nor C₃N 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 HC₃N, and the dominant formation mechanism of C₃N⁻ is likely to be the dissociative electron attachment to HC₃N⁻. The radiative association of C₃N with electrons seems to be unlikely at least for the extended negative glow discharge. Apparently HC₃N is synthesized by a fast neutral and neutral reaction, C₂H₂ + CN → HCN + 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 HC₃N. Another isomer, HNCCC, has also been observed with much weaker signal intensity. This species might have been produced by the dissociative recombination reaction of HC₃NH⁺ with electrons, although the detection of this cation has not been successful in this type of discharge.