Chemistry of Cyanopolyynes in Hot Core Regions

K. Taniguchi,[1,2] M. Saito,[1,2] H. Ozeki,[3] Y. Miyamoto,[2] H. Kaneko,[2] T. Minamidani,[1,2]
F. Nakamura,[1,4] T. Hirota,[1,4] K. Dobashi,[5] T. Shimoikura[5]

[1]*Department of Astronomical Science, SOKENDAI, Japan*
[2]*Nobeyama Radio Observatory, National Astronomical Observatory of Japan, Japan*
[3]*Department of Environmental Science, Toho University, Japan*
[4]*National Astronomical Observatory of Japan, Japan*
[5]*Department of Astronomy and Earth Sciences, Tokyo Gakugei University, Japan*

Cyanopolyynes ($HC_{2n+1}N$; n=1-5) are one of the representative series of carbon-chain molecules. Carbon-chain molecules are good indicators of starless and star-forming cores; carbon-chain molecules are abundant in young starless cores and decrease as progress of the star formation processes[1]. However, two low-mass star forming cores where various carbon-chain molecules are abundant were discovered, and these regions were named Warm Carbon Chain Chemistry (WCCC) sources[2].

On the other hand, there are few studies about carbon-chain molecules in high-mass star forming regions, and our understanding is poor. We then carried out observations toward hot cores with the Nobeyama 45-m radio telescope, the Green Bank 100-m telescope, and the Very Large Array (VLA) in order to study chemical mechanisms of carbon-chain molecules in hot core regions.

We derived ^{13}C isotopic fractionation of HC_3N toward G28.28-0.36 by observations of the three ^{13}C isotopologues with the Nobeyama 45-m telescope. The abundance ratios are found to be 1.0(±0.2):1.00:1.47(±0.17) for [$H^{13}CCCN$] : [$HC^{13}CCN$] : [$HCC^{13}CN$]. The observational results imply that the neutral-neutral reaction between C_2H_2 and CN overwhelms other formation pathways, which is consistent with the chemical model calculation[3].

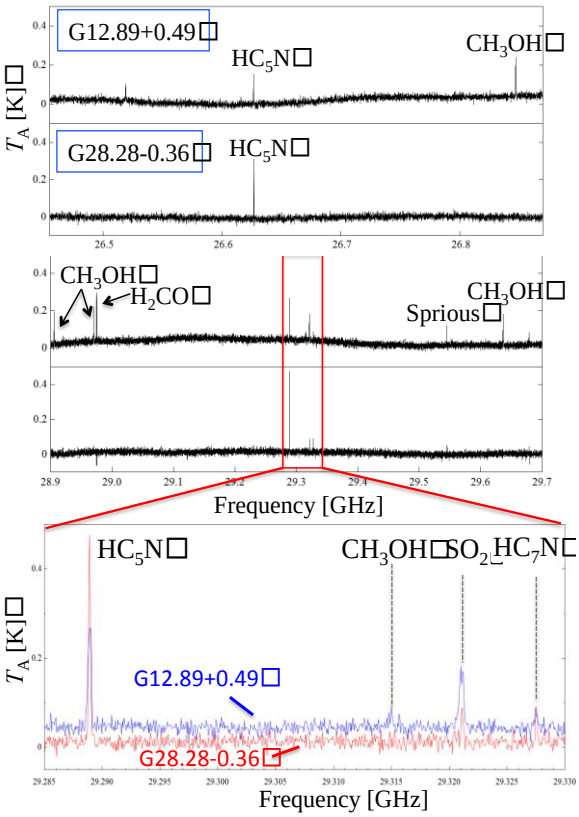

Figure 1. The spectra in two hot cores obtained with the Green Bank 100-m telescope.

We also detected HC_7N toward 2 hot cores, G28.28-0.36 and G12.89+0.49, with the Green Bank 100-m telescope at the time of writing the abstract (Figure 1). Our high-spatial-resolution maps with the VLA toward G28.28-0.36 show that the spatial distributions of cyanopolyynes (HC_3N, HC_5N, and HC_7N) are similar to that of CH_3CN, which is a hot core tracer. Based on these observational results, we consider that there is a possibility that cyanopolyynes can be efficiently formed in hot core regions.

References

[1] H. Suzuki et al., 1992, ApJ 392, 551
[2] N. Sakai & S. Yamamoto, 2013, Chem. Rev., 113(12), 8981
[3] J. F. Chapman et al., 2009, MNRAS, 394, 221