Spatial Distribution of Ices in a High-mass Star-forming Region

Takashi Shimonishi[1], Takashi Onaka[2], Itoh Yoichi[3], Itsuki Sakon[2],
Yuri Aikawa[1], Hideaki Fujiwara[4], and AKARI/IRC team

[1]Kobe University, Japan, [2]The University of Tokyo, Japan, [3]University of Hyogo, Japan,
[4]National Astronomical Observatory of Japan

Infrared absorption spectroscopy toward molecular clouds suggests that the bulk of heavy elements exist in the solid-phase as ice mantle. Chemical reactions in the solid-phase differ from gas-phase reactions in various aspects and they play an essential role in the chemical evolution of star-/planet-forming regions. Understanding the effect of star-formation activities on properties of ices is one of the key issues for ice chemistry. For this purpose, spectroscopic mapping observations provide us important information on processing of ice mantles in star-forming regions. However, almost previous observations of ices are limited to single line-of-sight spectroscopy, and so-called "ice mapping" observations are currently very few. Thus we have to say that our knowledge about spatial distribution of ices in star-forming regions is still poor.

Cepheus A East, one of the closest high-mass star-forming regions to the sun (~650 pc), is a prime target of this study. Previous infrared observations by ISO reported a wealth of ice absorption bands toward this region, suggesting its chemically-rich nature. In this study, we performed near-infrared (2 - 5 micron) imaging and spectroscopic observations toward Cepheus A East with the spatial resolution much higher than ISO by using AKARI/IRC, IRTF/SpeX and Subaru/IRCS. We detected absorption bands of major ice species (H_2O, CO_2, CO) as well as P- and R-branch lines of gas-phase CO toward various regions in Cephes A East. This enabled us to map the spatial distribution of ice mantles and spatial variation of ice chemical compositions around high-mass protostellar objects. In this presentation, we discuss the effect of radiation and outflows from protostellar objects on the chemical and physical properties of circumstellar ices based on the infrared spectroscopic data.