Mineralogy of interplanetary dust investigated from mid-infrared spectroscopic observations with AKARI

Aoi Takahashi[1], Takafumi Ootsubo[2], Hideo Matsuhara[2], Fumihiko Usui[3], Hiroki Chihara[4], and Itsuki Sakon[5]

[1]*Astrobiology Center, Japan,* [2]*Institute of Space and Astronautical Science, Japan,* [3]*Kobe University, Japan,* [4]*Osaka Sangyo University, Japan,* [5]*The University of Tokyo, Japan*

Interplanetary dust (IPD) diffusely distributes in the interplanetary space in our solar system and is thought to be recently supplied from primordial planetesimals like asteroids or comets. The IPD's grain properties, such as mineral composition and crystal morphology, can give us the information on the environment in the proto-solar system. Those properties can be investigated in terms of silicate features around 10 μm seen in the zodiacal emission spectra, because its feature shape is determined by the absorption coefficients of the IPD grains included in the line of sight, which depend on their grain properties.

We analyzed mid-infrared slit-spectroscopic data of the zodiacal emission in 74 different sky directions obtained with the Infrared Camera on board the Japanese AKARI satellite. After we subtracted the contamination due to instrumental artifacts, we have successfully obtained high signal-to-noise spectra and have detected detailed shapes of excess emission features in the 9–12 μm range in all the sky directions (Takahashi et al. submitted).

From the comparison between the feature shapes averaged over all directions and the absorption coefficients of candidate materials, the typical properties of the IPD were identified. As candidate materials, we assumed 4 types of silicate: amorphous with olivine composition, amorphous with pyroxene composition, forsterite (Mg_2SiO_4, one of olivine crystals), and ortho-enstatite ($MgSiO_3$, one of pyroxene crystals). The IPD was found to typically include small silicate crystals that appear to be enstatite-rich. If we focus on a main peak seemed to originate from enstatite, the peak wavelength is shifted toward longer side compared with the model assuming the spherical enstatite grains. It may indicate that the enstatite grains in the IPD have crystal morphologies not spherical but elongated along certain crystal axes.

We also found the variations in the feature shapes and the related grain properties among the different sky directions. The spectra at higher ecliptic latitude showed a stronger excess, which indicates the size distribution biased toward small grains in the lines of sight at high ecliptic latitudes. According to the dependence of detailed feature shapes on ecliptic latitudes, the IPD at higher ecliptic latitudes was found to have a lower olivine/(olivine+pyroxene) ratio for small amorphous grains. The variation of the mineral composition of the IPD in different sky directions may imply different properties of the IPD from different types of parent bodies, because the current spatial distribution of the IPD depends on the type of parent body.