

Effect of Space Weathering on Identification of Organic Matter on Celestial Body Surface Using Ultraviolet Wavelength Region Spectrum

*Shogo Arao¹, Ichiro Yoshikawa², Kazuo Yoshioka², Itsuki Sakon¹, Reina Hikida¹, Izumi Endo¹, Riku Katsuse²

1. Graduate School of Science, The University of Tokyo, 2. Graduate School of Frontier Sciences, The University of Tokyo

Analysis of reflection spectrum has been considered to be a conventional means for identifying compositions of the celestial body's surface, but in the ultraviolet region, it has rarely been conducted. There are a few reports which suggest the existence of polycyclic aromatic hydrocarbon (PAH) in interstellar dust and on the surface of Mars' moon Phobos on the basis of analytical results of their absorption or reflection spectrum, but the replication study is insufficient. A comparison of the spectrum of mixtures including various PAHs which exist on the earth with that of interstellar dust or the Phobos surface suggests that there are similarly shaped absorption bands at wavelengths of 210 nm and 217.5 nm respectively. This similarity of the shapes of absorption bands is the basis of the hypothesis that PAHs are present in interstellar dust and on the Phobos surface. However, considering the gap of peak wavelength, there are also many negative opinions on the hypothesis that is based on the doubtful similarity. Thus, there has been no definitive conclusion until now. One of the phenomena that may have a description for this problem is change in the absorption spectrum due to space weathering. The absorption band of PAHs around the wavelength of 210 nm is caused by the transition of aromatic π electrons. This band appears significantly in the absorption spectrum of molecules which have many bound aromatic rings, so that those orbital area of aromatic π electrons is broad. If the hydrogen atoms bonded to the aromatic rings of PAH molecules are desorbed by space weathering, it is suggested theoretically that the orbital area of aromatic π electrons is broadened and the absorption band's peak wavelength may approach 217.5 nm. In our study, to evaluate the influence of space weathering on the optical properties of PAHs, we prepared several PAH samples which had been exposed to the space environment for about 1 year on orbit of the International Space Station (ISS). These were several of the samples loaded onto ISS's exposure facility, ExHAM, of the Japanese experiment module, Kibo, as a research agenda, "Empirical Study on Space Weathering of Carbonaceous Solid Fine Particles and Organic Evolution". Then, we compared the reflection characteristics of these samples with those of non-exposure samples in a wavelength region of 100-300 nm. As a result, some samples experienced space weathering tended to reflect the light in 210-300 nm wavelength region more weakly. In the presentation, evaluation and consideration of this result will be the focal points of the discussion.

Keywords: interstellar dust, Phobos, polycyclic aromatic hydrocarbon, Space Weathering