The development of UV spectrometer and preliminary measurement of carbonaceous chondrites

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Ultraviolet (UV) reflectance spectra (200-400nm) of carbonaceous chondrites provide new information on organic matters in C-complex asteroids [e. g., 1], but interpretation of UV reflectance spectra of carbonaceous chondrites are not well established [1–3] because of very low reflectivity of the meteorites and the lack of best-suited standards in the UV region.
In this study, we developed a UV spectrometer and made selection of the best-suited standard material for calibration. High sensitivity is required for the spectrometer, because primitive meteorites such as carbonaceous chondrites are very dark in the UV wavelength region. The detector is an Ocean Optics Maya2000 PRO that has sensitivity in a range from 165 to 620 nm and spectral resolution of 0.035–0.68 nm. Light source is Hamamatsu Photonics Deuterium lamp (H2D2 light source unit) L11799 that has intensity in a range from 160 to 400 nm with atmospheric UV-radiation. We set a light source, meteorite sample, and a detector with minimum distance each other with a phase angle of 30 degrees. We tested and evaluated a wide variety of natural and artificial materials as a candidate for a reflectance standard, including $BaSO_4$, CaF_2, and Quartz, in a way similar to those described in [2]. The results of the test measurements suggest that Quartz powder is the best standard in the ultraviolet region, because it shows relatively flat spectrum compared with the other candidates.
For preliminary measurements of carbonaceous chondrites, we measured hydrated and partially- or completely dehydrated CM chondrites (Murray, Murchison, Yamato (Y-) 793321, Jbilet Winselwan, Murchison heated at 600˚C, Belgica (B-) 7904, Y86720). They are classified to heating stages I-IV (stage IV is the highest heating degree) based on mineralogical evidence [4]. They were crushed into a powder with <77 or <155 μm in size and used for spectral measurements. The results show that overall UV reflectance decreases from stage I to II, but increases with increasing heating stages from II to IV, whereas spectral slope in the 200-400nm region decreases with increasing heating degree. These changes are consistent with those observed in [1] and probably attributed to graphitization of IOM (Insoluble Organic Matter) in carbonaceous chondrites with increasing heating temperature.

References: [1] Applin, D.M. et al. (2018) Icarus, 307, 40-82. [2] Cloutis E.A. et al. (2008) Icarus, 97, 321-347. [3] Trigo-Rodriguez J.M. et al. (2014) Monthly Notices of the Royal Astronomical Society, 437, 227-240. [4] Nakamura, T. (2005). Journal of Mineralogical and Petrological Sciences, 100(6), 260-272.

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