Mid-Infrared Spectroscopic Observations of the Classical Nova V2676 Oph with Subaru/COMICS

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A classical nova is an explosive event with a sudden increase in brightness that occurs on a white dwarf (WD) star. The explosion of the gas envelope of the WD (accreted from the companion star) is powered by thermonuclear runaway reactions that occur at the base of the envelope. The nature of the WD star is essential to the chemistry of the ejected material in novae. A dust-forming nova V2676 Oph (discovered in Mar 2012) was the first nova to provide evidence of both C_2 and CN molecules during its near-maximum phase and evidence of CO molecules during its early decline phase [1]. The derived carbon- and nitrogen-isotopic ratios in the nova [2] are consistent with that the nova explosion was hosted by a CO-rich WD rather than an ONe-rich WD. The existence of both C_2 and CN radicals in the photosphere indicates that the nova envelope was C-rich, with C/O > 1 [3]. To confirm a type of the hosting WD (CO-rich or ONe-rich), we performed the mid-infrared imaging and low-resolution spectroscopic observations of V2676 Oph with COMICS mounted on the Subaru telescope in June 2013 and May 2014 (482 days and 782 days respectively after its discovery) [4]. No clear [Ne II] emission line at 12.8 μm was observed in either the 2013 or 2014 observations. Based on the absence of [Ne II] emission, the WD hosting V2676 Oph is considered a CO-rich WD. Both types of dust grain, carbon-rich and oxygen-rich, were detected on both dates, although this nova is considered as a Carbon-rich (C/O > 1) based on the presence of C_2 observed earlier. The 11.4 μm unidentified infrared (UIR) emission was also detected on these dates. The coexistence of UIR carriers and carbon-rich grains in V2676 Oph supports the formation of UIR carriers from amorphous carbon grains. Non-equilibrium processes are likely to be responsible for the grain formation in the nova.

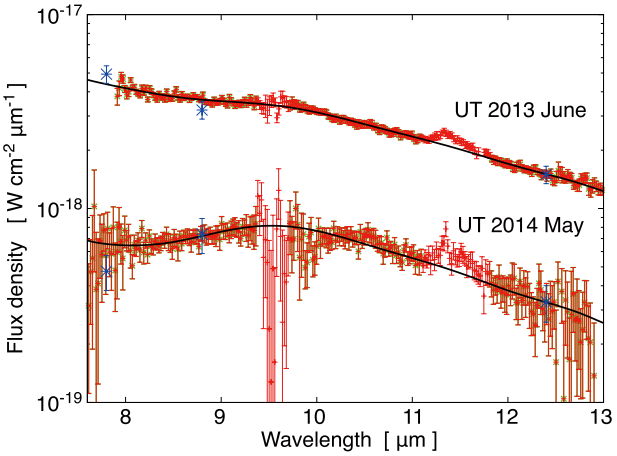

Figure 1: Low-resolution N-band spectra of V2676 Oph taken on UT 2013 June 20 and UT 2014 May 16. We assumed the grain radii for amorphous carbon and astronomical silicate to be 0.1 μm to reproduce the observed spectra. The UIR emission at 11.4 μm is clearly detected in both spectra [4].

References

[1] Nagashima, M., et al.: 2014, *ApJL*, **780**, L26.
[2] Kawakita, H., et al.: 2015, *PASJ*, **67**, 17.
[3] Kawakita, H., et al.: 2016, *PASJ*, **68**, 87.
[4] Kawakita, H., et al.: 2017, *AJ*, **153**, 74.