Mid-infrared Spectroscopic Monitoring of Mira Variables HV2446 and IRAS04544-6849 -Signature of Silicate Formation?-

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Asymptotic Giant Branch (AGB) stars are well known as a birth place of interstellar dust grains. Their formation process is still ambiguous and an interesting problem. AGB stars are generally pulsating variables, and Miras are one kind of them. Their pulsation creates dense gas moving away from the stars, and circumstellar grains are born in it when it reaches the regions where the grains can be thermally stable. Such scenario is believed, but not fully confirmed observationally. To investigate the formation of silicate grains, we have monitored mid-infrared spectra of two Miras.

The targets are the bright M-type (Oxygen rich) Mira variables in the Large Magellanic Cloud (LMC), HV2446 and IRAS04544-6849. Their main-sequence masses are about 5 and 3 $M_{\odot}$, respectively. Their variability periods are about 600 and 700 days, respectively. Each object has been observed six times in one variability cycle with the Infrared Spectrograph (IRS) onboard the Spitzer Space Telescope (*SST*).

In all obtained spectra (R~60-130, λ=5.2-38 μm), both objects showed the strong silicate emission bands around 10 and 18 μm. Both features got stronger, and the strength ratio of the 10-μm feature over the 18-μm feature got higher toward the visual maximum phase. Such time variability has been also pointed out for some Mira variables by the previous works (Little-Marenin et al. 1993, Onaka et al. 2002). The mechanism of this variability is still under discussion, and two interpretations can be given. One is temperature variability of the dust shell induced by the stellar luminosity variation. The other one is formation and/or destruction of the silicate grains. We analyzed the spectra with a simple model with an optically thin spherical dust shell to investigate which mechanism causes the variability.

As the result, the spectral variation of them except the visual maximum phase was explained by only the temperature change. It means that the significant formation and destruction of the silicate grains did not occur during the term. This is the same result as the previous work of Onaka et al. (2002) about another Mira, Z Cyg. On the other hand, the spectra in the visual maximum phase could not be reproduced only by the temperature change. It was found that the 10-μm feature is too strong to model with matching the overall strength of the features. One way to reproduce the spectra is adding hot silicate grains unlike warming up the all dust. It can strengthen the 10-μm feature without too much increase of the overall strength. The additional hot silicate can be interpreted as the signature of such newly formed silicates. This interpretation proposes that the silicate grains are formed episodically in the same scenario as mentioned above.