

Public Abstract

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Title: On the Astromineralogy of the 13 Micron Feature in the Spectra of Oxygen-Rich AGB Stars

Intermediate-mass stars (0.8-8.0 solar masses) are major contributors of new elements to interstellar space. These stars eventually evolve into asymptotic giant branch (AGB) stars. During the AGB phase, these stars lose mass to their surroundings, leading to the creation of circumstellar shells of gas and dust. Asymptotic Giant Branch (AGB) Stars have several interesting infrared spectral features.

Approximately half the oxygen-rich AGB stars to be investigated spectroscopically exhibit a feature at 13 μm . Furthermore, the 13 μm feature is associated with semiregular variables (SRs) rather than Miras or red supergiants. While Miras and SRs differ in several ways, with respect to their circumstellar shells, the important difference is that Mira shells are optically thicker than SR shells. Therefore, identification of the 13 μm feature provides a diagnostic for the effect of differing circumstellar shell parameters on dust formation.

The carrier of this feature has not yet been unequivocally identified, but has been attributed to various dust species, including corundum ($\alpha\text{-Al}_2\text{O}_3$), spinel (MgAl_2O_4) and silica (SiO_2). In order to constrain the carrier of the 13 μm feature, we have used the 1-d radiative transfer code DUSTY to model the effects of composition and optical depth on the shape and strength of the emerging 13 μm feature from corundum, spinel and quartz grains. We have modeled various abundances of corundum, spinel and quartz together with warm silicate and/or amorphous alumina in dust shells surrounding O-rich AGB stars. These models demonstrate that

- i) spinel is unlikely to be the carrier of the 13 μm feature;
- ii) if corundum is present in these circumstellar dust shells, even at very low relative abundances, a 13 μm feature should be observed;
- iii) corundum's weak ~ 21 μm feature will not be observed, even if it is responsible for the ~ 13 μm feature;
- iv) corundum grains must be spherical to exhibit the 13 μm feature. Other grain shapes (spheroids, ellipsoids, hollow spheres) shift the features to longer wavelengths for both spinel and corundum.
- v) if silica grains are the carrier of the 13 μm feature they are unlikely to be either spherical or the polymorph quartz.

More laboratory optical data for the polymorphs of silica are needed to determine whether they are the carrier of the ~ 13 μm feature.