The Abundance of SiC_2, SiO, SiS and CS in Carbon Star Envelopes

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The synthesis of dust grains mostly takes place in the circumstellar envelopes (CSEs) of asymptotic giant branch (AGB) stars. What are the precursor seeds of condensation nuclei and how these particles evolve toward the micrometer sized grains that populate the ISM are key questions of the NANOCOSMOS project. In this study, we carried out observations with the IRAM 30m telescope of 25 C-rich AGB stars of diverse mass-loss rates to search for emission of SiC_2, SiO, SiS and CS in the λ 2mm band. The observations have been interpreted carrying out non-LTE excitation and radiative transfer calculations to estimate the fractional abundance of these molecules in the CSEs. Interestingly, the fractional abundance of SiC_2 shows a trend with the density in the envelope, evaluated through the quantity $\dot{M}/V_{exp}$. As shown in Fig.1, SiC_2 becomes less abundant as the density in the envelope increases. We interpret this as that the SiC_2 molecules deplete from the gas phase to incorporate into solid dust grains[1]. SiC_2 thus emerges as a very likely gas-phase precursor in the process of formation of SiC dust in envelopes around C-rich AGB stars. We note a similar trend for SiO and CS, which we interpret as evidence of efficient adsorption of SiO and CS onto dust grains. In contrast to these results, SiS does not show any clear trend, suggesting that it is less likely to adsorb onto dust grains than SiC_2, SiO and CS (Massalkhi et al. in prep).

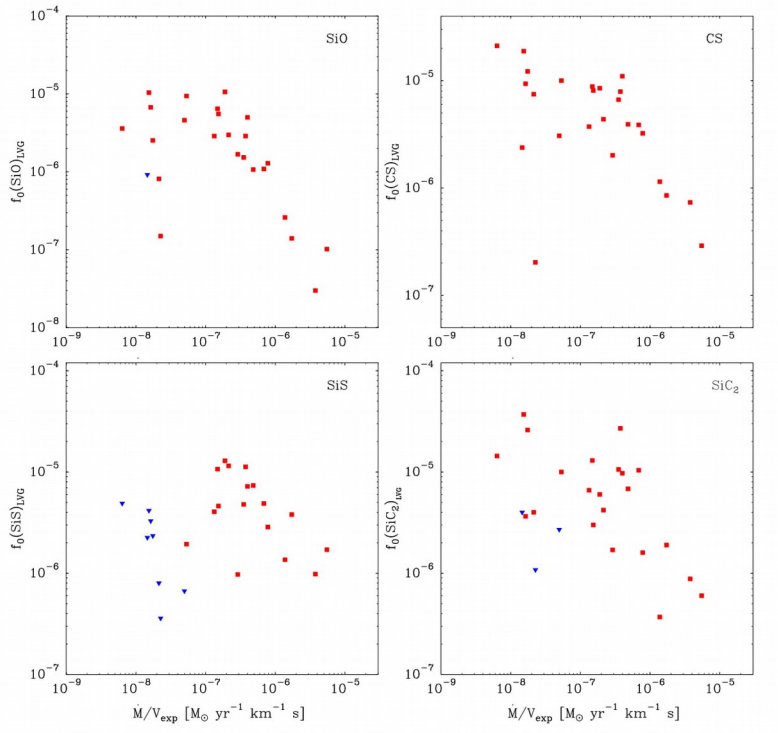

Figure 1: Fractional abundances relative to H_2 obtained from radiative transfer analysis, as a function of $\dot{M}/V_{exp}$ for our sample of C-rich AGB stars. Upper limits from non-detections are denoted with downward triangles..

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References

[1] Massalkhi, S., Agúndez, M., Cernicharo, J., et al. 2018, A&A, 611, A29.