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ABSORPTION EFFICIENCIES OF STARDUST MINERALS

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Oxide and silicate minerals are not only important components of the Earth's mantle, but they form also as small solid particles ("dust grains") in the extended atmospheres of pulsating red giant stars at temperatures below 1500 K. Astronomical infrared spectroscopy, combined with measurements of "cosmic dust analogues" in the laboratory, has enabled significant progress in the identification of IR emission bands detected at wavelengths between 8 and 70 µm in the spectra of circumstellar shells. We present results of this combined laboratory and astronomical spectroscopy approach to the task of establishing a circumstellar dust mineralogy (see DORSCHNER in HENNING, 2003).
The present contribution is focused on the absorption efficiencies of astronomically relevant oxides like the TiO_2 modifications anatase (RICHTER et al., 2004) and rutile (POSCH et al., 2003) and $MgAl_2O_4$ (spinel) (FABIAN et al., 2001). Reflectance and transmittance measurements of these materials result in new refractive indices (n) and absorption indices (k) in the NIR (0.5 – 2.5 µm) & MIR (2.5 – 25 µm) range. The n and k values are not sufficient for the calculation of model spectra of dust enshrouded astronomical objects. Therefore, we derived absorption efficiencies (Q_{abs}) for different particle shapes (e.g. spheres) from the n and k values of different materials according to the numerical schemes compiled by BOHREN & HUFFMAN (1983). These Q_{abs} values are different from those derived from measurements of powder samples which contain grains of unknown shape and orientation. Only Q_{abs} can be compared with the spectra of circumstellar dust shells. We show the influence of grain shapes on Q_{abs} and compare spinel's and other minerals' Q_{abs}-profiles with astronomical emission bands.
On the basis of the absorption efficiencies it is also possible to calculate the temperature of the dust grains in circumstellar shells. For selected minerals, we demonstrate also the influence of the magnitude of k in the NIR on stardust radiative equilibrium temperature (RICHTER et al., 2004).

References

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