PROBING THE INNER ACCRETION DISK USING SPITZER C2D MID-INFRARED SPECTRA.

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The dust composition, the lattice structure and the size of silicate grains is expected to be strongly modified in circumstellar disks around young stars. To probe the inner regions of accretion disks and to derive the dust properties in planet-forming regions, we obtained a large sample of infrared spectra (5-35 μm) of disks around Class II stars using the IRS instrument onboard Spitzer. In this poster we present the results obtained using mid-infrared spectroscopy to evidence silicate emission features in disks around Herbig Ae/Be stars (HAEBE), T-Tauri stars (TTs) and brown dwarves (BDs).

Observed silicate features and stellar luminosity :

The correlation between the 10 μm silicate emission strength and its shape is seen in a large sample of stars, from HAEBE to TTs and BDs (Fig. 1). This correlation indicates that BDs have, in average, flatter silicates features than TTs, which can be interpreted as bigger grains toward lower-luminosity stars. Kessler-Silacci et al. (2006) qualitatively explained this correlation by the combined effects of higher stellar luminosity probing larger distances, and grain-size distribution peaking toward smaller grains at larger distances.

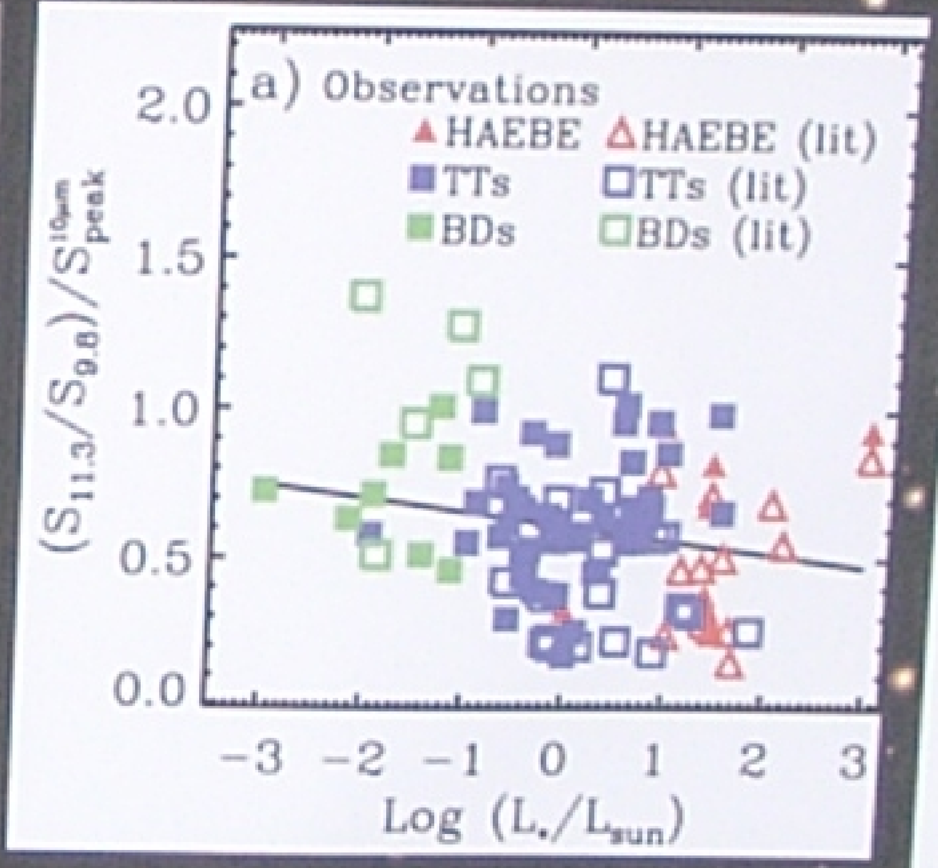
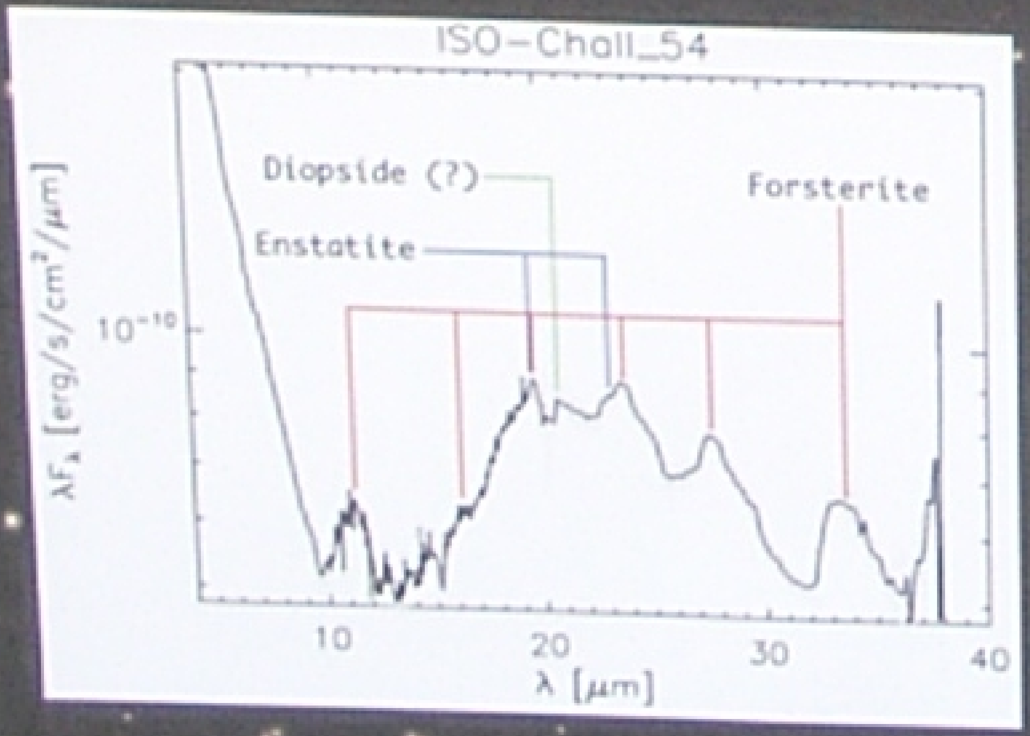


Figure 1 : Grain size parameter versus stellar luminosity (from Kessler-Silacci et al. 2007). Peaked silicates features show up toward the right and flatted features from the left (105 objects selected on their 10 μm and 20 μm silicate features).



Observed crystallinity :

Some sources show very strong crystalline silicate features like the brown dwarf candidate ISO-ChaII 54 (Fig. 2). The degree of crystallinity is rather high in our c2d IRS sample (115 Class II objects) : ~ 80% of the objects show at least one feature that can be attributed to crystalline silicates.

Crystalline silicate grains have been detected at larger distances than those where they have been formed, close to the star, mainly via thermal annealing. Several mechanisms could explain this migration : turbulent mixing, winds or outward moving of the midplane (Keller & Gail 2004).

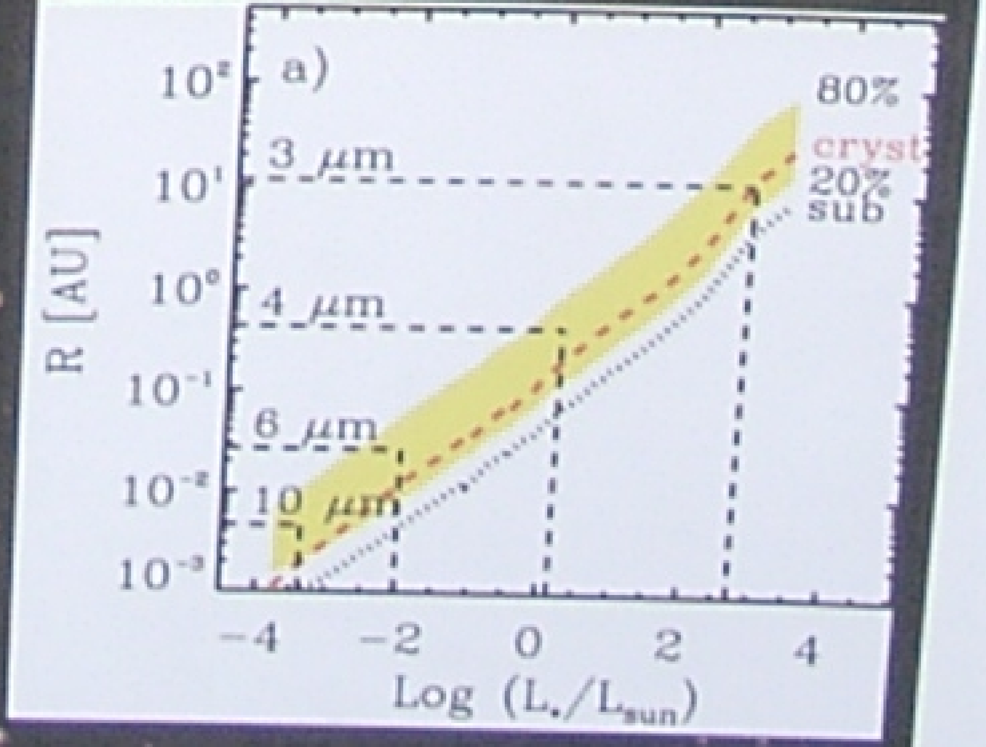
But it can hardly explain the high crystallinity degree (15-33%) found in the borderline BD SST-Lup3-1 studied by Merín et al. (2007) where the crystalline signatures are arising from the 3-5 AU region.

Modeled silicate emission zones :

Modelisation of flared disks as a function of central luminosity helps to better understand the correlation between grain size and luminosity. The figure on the right (from Kessler-Silacci et al. 2007) has been obtained using the CGPLUS 2-layer disk model of Dullemond et al. (2001).

The yellow solid region shows the radii contributing 20-80 % of the 10 μm emission zone. The relation between luminosity and distance of the emission zone is given by $R_{10}=0.35$ AU $(L_*/L_\odot)^{0.56}$.

This figure shows that the grain size inferred from the silicate features may be influenced by the luminosity of the central object (via the location of the 10 μm emission zone), and by differential grain growth along the disk.



References :

- Kessler-Silacci et al. 2006, ApJ, 639 : 275
- Kessler-Silacci et al. 2007, ApJ, 659 : 680
- Dullemond et al. 2001, ApJ, 560 : 957
- Keller & Gail 2004, A&A, 415 : 1177
- Merín et al. 2007, ApJ, 661 : 361