Composition of dust in a debris disk --- presence of Fe-bearing crystalline silicate ?

Mitsuhiko Honda[1]; Hirokazu Kataza[2]; Yoshiko Okamoto[3]; Takashi Miyata[4]; Takuya Yamashita[5]; Shigeyuki Sako[1]; Takuya Fujiyoshi[6]; Takashi Onaka[1]

[1] Department of Astronomy, University of Tokyo; [2] ISAS; [3] Institute of Physics,Kitasato University; [4] Insititute of Astronomy,University of Tokyo; [5] National Astronomical Observatory,Japan; [6] Subaru Telescope, NAOJ

We report 8-13 micron spectroscopic obeservations of Vega-like stars using the COoled Mid-Infrared Camera and Spectrometer (COMICS) on the 8.2m Subaru Telescope to study the dust properties in debris disks. Vega-like stars are main-sequence stars with infrared excess emission from circumstellar dust. Such dust is supoosed to be the second generation dust that was formed by collisions of planetesimals and/or evaporation of comets around the star. Therefore, these dust disks are called 'debris disks' in contrast to 'protoplanetary disks'.

We observed 7 Vega-like stars with possible excess emission at 10 micron (HR4796, 49Cet, HD142096, HD145263, HD176638, HD178253, HD4881). 6 objects showed no significant silicate emission features. It can be attributed to (1) too low temperatures or too a small amount of dust grains to show significant 10 micron excess emission, or to (2) the lack of small (a few micron) silicate grains which show the 10 micron silicate features.

On the other hand, HD145263 shows the silicate feature with a signature of crystalline silicate dust. This is the 2nd observational sample which shows the presence of crystalline silicate around Vega-like stars, thus crystalline silicate seems ubiquitos around Vega-like stars. Furthermore, HD145263 has a feature at 11.4 micron. This feature is difficult to explain in terms of crystalline forsterite (Mg2SiO4), which has a feature at 11.2 micron and is sometimes discovered around young precursors such as Herbig Ae/Be stars and T Tauri stars. There are some explanations for this 11.4 micron feature. Although other possibilities cannot be ruled out completely, we suggest that this 11.4 micron feature could be attributed to the presence of Fe-bearing crystalline olivine. According to the measurement by Koike et al., 2003, A&A, 399, 1101, Fe-bearing crystalline olivine generally shows the feature at longer wavelengths compared to Mg-pure olivine (forsterite).

According to studies of primordial meteorites (Krot et al. 2000, in Protostars and Planets IV), Fe-bearing silicate (fayalitic olivine) seems to be formed in the parent body of meteorites. Therefore, the presence of Fe-bearing crystalline silicate around Vega-like stars suggests evidence for the scenario that the dust around Vega-like stars is replenished by planetesimals.