P066-009 Room: 303 Time: May 26 11:15-11:30

Condensation of silicate dusts around stellar environments

Hiroko Nagahara[1]

[1] Dept. Earth Planet. Sci., Univ. Tokyo

Silicate dusts have recently been reported around evolved and young stars: (1) forsterite and enstatite in the outflow around O-rich AGB stars (Jager et al., 1998), (2) amorphous silicate + Fo + En +H20 ice on amorphous silicate (Hoogzaad et al., 2002) and Fo + En (Molster et al., 2002) in the circumstellar dust shells around post AGB stars, (3) ol + px in a planetary nebula (Waters et al., 1998), and (4) amorphous silicate + Fo or amorphous olivine around Herbig Ae/Be to Beta Pictoris (Waslkens et al., 1996; Meeus et al., 2001, Bowman et al., 2001) and Fo + En (?) + SiO2 around T Tauri stars (Hondo et al., 2002). The observations show formation of crystalline silicate, particularly forsterite and enstatite, in a wide range of stellar conditions. The condensation conditions of silicate dust in the wind of Red Giant is estimated to be P = 1E-10 bar and T = 600 to 1600 K, which originated in the stellar photosphere with T = 2500K and P = 1E-4 bar (Ferrarotti and Gail, 2002). The outflow velocity of intrinsic S stars are estimated to be 5 to 20 km/s, which means condensation time of silicate dust to be seconds to several days and which should be a highly disequilibrium condition. On the other hand, the condensation conditions of silicate dusts in accretionary discs around young stars change largely with evolution of the disc where the time scale changes from 1E2 to 1E6 years, and the condensation is close to equilibrium.

The stability of forsterite and enstatite in equilibrium with gas is investigated for the conditions of S stars and protoplanetary disc in the present study taking the presence of silicate melt into consideration. Most of previous work that studied condensation in stellar environments treated gas and crystalline silicates, which does not consider melt. The results show that silicate melt is stable in relatively high pressures, and that forsterite has a wide stability field for wide range of gas composition including Mg/Si. Enstatite appears as a first condensate in a very restricted condition, suggesting that it hardly condenses coexisting with forsterite in stellar wind of AGB stars, because formation of enstatite requires reaction of forsterite and gas, which is highly inhibited due to rapid cooling of the gas. Enstatite can be formed coexisting with SiO2 (or its amorphous material) when the Mg/Si ratio of the gas is smaller than the solar ratio. The average cosmic Mg/Si ratio is, however estimated to be larger than the solar system, and therefore, enstatite formation in AGB stars is estimated to be highly inhibited. If enstatite is really condensed in the wind of evolved stars, it indicates the higher pressure conditions than that generally estimated. Enstatite formation around protoplanetary disc is, on the other hand, much more easy where the long evolution time scale enables the reaction of forsterite and gas to form enstatite.