Japan Geoscience Union Meeting 2011
(May 22-27 2011 at Makuhari, Chiba, Japan)

PPS025-P03 Room:Convention Hall Time:May 23 10:30-13:00

Evolution of infrared spectra in crystallization by heating of amorphous magnesium silicates

Yuta Imai[1*], Chiyoe Koike[1], Chihara Hiroki[1], Yoshihiro Nakamuta[2], Akira Tsuchiyama[1]

[1]Earth and Space Sci., Osaka Univ., [2]Kyushu University Museum, Kyushu Univ.

Comparison between infrared spectra of astronomical observations and laboratory measurements revealed that circumstellar and interstellar dust has been investigated, crystalline silicates (e.g., olivine ($(Mg;Fe)_2SiO_4$), and pyroxene ($(Mg;Fe)_2SiO_3$) exist in circumstellar environments around oxygen rich young and evolved stars(e.g., Waelkens et al. 1996; Waters et al. 1996). It is possible that the crystalline silicates are formed by crystallization by heating from amorphous silicate in the circumstellar environments. For example, a precursor material for the crystalline silicates in circumstellar regions around young stars is considered to be interstellar amorphous silicate dust, which is believed almost completely amorphous (Kemper et al. 2004). And, in circumstellar regions around evolved stars, it is considered that amorphous silicates condense from out flow gas and are partially crystallized by heating. In order to reveal the conditions of circumstellar environments, it is important to understand crystallization process of the silicates. In recent years, distributions of minerals and crystallinity in protoplanetary disks around the T Tauri stars are estimated by comparison between the 10 um infrared emission arising from inner warm regions in the protoplanetary disks and the 20 um emission arising from more distant regions (e.g. Olofsson et al., 2010). In order to discuss the properties of the circumstellar dust, it is necessary to investigate evolution of infrared spectra at each wavelength region particularly.

As starting materials of heating experiments, amorphous silicates with the enstatite composition (Mg/Si =1) and the forsterite composition (Mg/Si=2) were synthesized using the radio frequency thermal plasma processing at Nisshin Engineering Co. Ltd. The amorphous samples were heated at various temperatures for various durations, and clinoenstatite ($MgSiO_3$) and forsterite (Mg_2SiO_4) were crystallized from the starting amorphous materials in the Mg/Si ratio of 1 and 2, respectively. By analyses of infrared absorption spectroscopy and x-ray powder diffraction of the heated samples, the degrees of crystallization were estimated. Then, we investigated the relation between the degree of crystallization and change of the infrared spectral features at each wavelength regions. At results, the infrared spectral features of the samples with forsterite component at around 20um change at a more rapid rate than those at around 10um in the crystallization process. On the other hands, the infrared spectra of the samples with enstatite composition have no such trend. By comparing between the results and astronomical observation of T Tauri stars, we discuss crystallization from amorphous silicate in circumstellar environments.

Keywords: infrared, dust, crystallization, amorphous silicate