Modeling the composition of the protoplanetary disk : carbon grain destruction effect

*Chen-En Wei[1], Hideko Nomura[1], Jeong-Eun Lee[2], Wing-Huen Ip[3]

1. Department of Earth and Planetary Sciences, Tokyo Institute of Technology, 2. Department of Astronomy and Space Science, Sejong University, Republic of Korea, 3. Graduate Institute of Astronomy, National Central University, Taiwan

The bulk composition of Earth is dramatically carbon poor compared to that of the interstellar medium, and this phenomenon extends to the asteroid belt. A gradient in the amounts of refractory carbon relative to silicate is shown in our solar system. To interpret the carbon deficit problem, we focus on two issues: (1) The carbon depletion gradient in the inner solar system. (2) Test the carbon grain destruction observationally. We assume two kinds of central stars T-tauri star and Herbig Ae star for the former and the latter issues, respectively. The results of the chemical models with and without the carbon grain destruction show significant differences especially in the inner region of the disk midplane, where CO gas is abundant and not photodissociated. Furthermore, we consider HCN and its isotopologue, $H^{13}CN$, as our candidate tracer of the carbon grain destruction, and make a prediction for the HCN and $H^{13}CN$ line intensity maps for the ALMA observations by applying their abundance distribution into the radiative transfer model for a Herbig Ae disk. The results indicate, the difference in the HCN/$H^{13}CN$ line emitting regions as well as their intensity ratio are useful tracers of the carbon grain destruction. In addition, the cumulative line flux as a function of the velocity will trace the line emitting regions and the difference between the HCN and $H^{13}CN$ lines will also be a tracer of the carbon grain destruction.

Keywords: protoplanetary disk, carbon depletion

