Effect of Dust Distribution on Chemical Structure in the TW Hya Disk

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Protoplanetary disks are the natal place of planets, and as a first step of planet formation, dust grains are thought to grow through collisional sticking, and then settle towards the disk midplane, drift radially and sometimes azimuthally to be piled up, depending on the gas distribution. In this work, we have modeled the physical and chemical structure of the TW Hya disk, based on the high spatial resolution observations of dust emission and molecular lines by ALMA. The observations of dust emission indicate the concentration of dust grains in the inner region of the disk[1][2], which will affect the UV radiation field, gas temperature, and then molecular line emission profiles. The result of our model calculations suggests that the flat distribution of ^{13}CO, $C^{18}O$ and CN line emission can be explained as a result of shielding of UV radiation in the inner region of the disk where dust grains are accumulated. In addition, the observed CN line is relatively strong compared with the ^{13}CO and $C^{18}O$ lines. This can be explained as a result of depletion of CO gas or depletion of elemental abundance of oxygen in gas. Further observations of molecular lines, such as the HCO^+ line, could be a clue to distinguish the origin of the possible depletion of gaseous species in the disk.

References

[1] H. Nomura, T. Tsukaghoshi, K. Ryohei et al. 2016, ApJL, 819, L7.

[2] T. Tsukaghoshi, H. Nomura, T. Muto et al. 2016, ApJL, 819, L7.