Contribution ID: **128** Type: **Poster**

Co-accretion of carbon molecules and silicate precursors at cryogenic temperatures

Wednesday 13 June 2018 14:43 (1 minute)

Dust grains are subjected to various destruction mechanisms in the interstellar medium (ISM). Together these mechanisms operate at a rate faster than the injection of grains condensed in stellar outflows and supernova ejecta. Nevertheless, comparatively long-lived dust populations are observed in the ISM. The local reformation or growth of grains has been proposed as a process that contributes to counterbalancing their destruction.

The growth is proposed to proceed through the accretion of atoms and/or molecules present in the interstellar gas phase, and subsequent chemical reactions that incorporate the accreted species to the grain. The reactions would take place in the cold neutral medium and in molecular clouds, i.e., at temperatures in the range 10 to 100 K. The bulk of interstellar dust, however, is constituted of silicate and carbonaceous grains. The formation of these refractory materials at cold interstellar temperatures has yet to be described in detail. Especially, the mechanisms that lead to the separation of silicate and carbonaceous materials observed by astronomers have to be determined.

We have already reported experiments showing the formation and growth of silicate grains at cryogenic temperatures through the accretion of cold atoms and molecules related to silicates. In the most recent experiments, carbon atoms and molecules (C_n, n = 1−10) were added to the silicate precursors. Significant amounts of H_2O, CO, CO_2, and C_3O molecules were also present. We have observed that amorphous silicates are formed despite the presence of the carbon molecules and the other species. These experiments will be presented and their relevance to the growth of silicate grains in the ISM will be discussed.

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Yes

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Session Classification: Poster Presentations

Track Classification: The creation and evolution of dust