Aggregation growth of various ice dust grains formed in laboratory experiment at astrophysically relevant temperatures

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Ice dust grains are frequently observed in many astrophysical objects such as molecular clouds, protoplanetary disks, and planetary rings. The ice dust grains play a critical role in the astrophysical objects: ice dust grains stick other dust grains together like a glue and help them to form planetesimals. However, the growth and morphology of dust grains formed in actual astrophysical objects are not directly observable. Therefore, a laboratory experiment is needed to understand the details of dust growth and morphology [1.2]. In this work, ice dust grains made of water, methanol and ethanol are produced in a laboratory plasma experiment and the growth mechanism and surface morphology of ice dust grains are studied. It is observed that both methanol and ethanol ice grains grow elongated and fractal-like (see Fig. 1) similar to water ice grains formed in a plasma [1,3]. The experiment also shows that methanol and ethanol ice grains grow faster, larger, and more branched than water ice grains. The observed growth features and morphology can be explained by the diffusion-limited aggregation [4]. It is also observed that larger and more branched ice grains are formed when the background gas pressure is low or when the mass of background gas is light, suggesting the aggregation growth of small monomers is enhanced under these conditions [4].

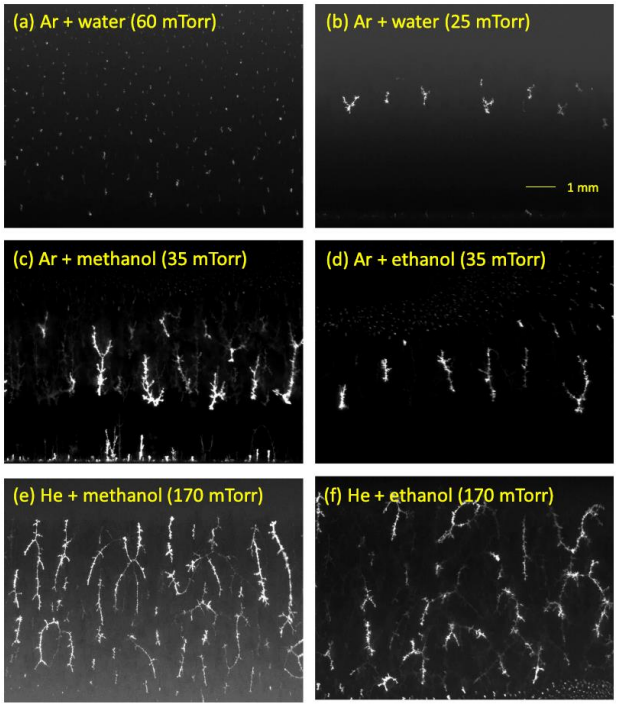

Figure 1 Photos of water-, methanol-, and ethanol-ice dust grains formed in Ar and He plasmas.

References

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