

Formation environment of matrix fine particles revealed by surface nano-topography

Jun Nozawa[1]; Katsuo Tsukamoto[2]; Hitoshi Miura[3]; Yuki Kimura[4]

[1] Geology, Sci., Tohoku Univ; [2] Graduate School of Science, Tohoku University; [3] Department of Earth Sciences, Tohoku University; [4] Tohoku Univ.

By means of nanoscale surface observation, we have proposed a new approach for investigating fine particles of cosmic materials to reveal their origin and growth conditions. Several different morphologies of polyhedral fine olivine particles with faceted faces have been found in Allende carbonaceous chondrite (4.56 billion years in geochronological age). In the present work, molecular level topography of the faceted matrix olivine by Atomic Force Microscopy (AFM) has successfully been performed. The original monomolecular growth steps of these fine particles are precisely recognized on the surfaces of matrix olivine. These growth steps are without doubt the oldest ones that human being has ever observed. The surface pattern suggests that the faceted matrix olivine could have been condensed from the gas phase, and possibly that these olivine crystals had continued to grow under a rapid cooling condition (0.1 to 1 K per second). The estimated cooling rate agrees well with predictions based on hypothetical rapid heating and cooling events such as shock wave heating.