THREE-DIMENSIONAL STRUCTURES OF METAL-SULFIDE GRAINS IN CO CHONDRITES: FORMATION OF METAL-SULFIDE CHONDRULES. M. Kitamura[1], A. Tsuchiyama[1], T. Nakano[2] and K. Uesugi[3], [1]Department of Earth and Space Science, Osaka University, [2]GSJ/NIST, [3]SP8/JASRI

Introduction: Metal and/or sulfide grains are one of the major constituents of chondrites as well as chondrules and matrix. In general, they are not considered as metal-sulfide droplets because of their irregular shapes. However, their behavior during chondrule formation has not been known well. Here, we made a working hypothesis that (1) these metal-sulfides grains were experienced heating and cooling processes as well as chondrules and (2) most of spherical metal-sulfide grains were deformed by rigid chondrules and become irregular in their shapes during or after accretion as chondrites. In order to verify this hypothesis we examined 3-D structures of metal-sulfide grains in ALH77003 (CO3.5) and Kainsaz (CO3.1) using X-ray computed tomography (CT).

Experiments: We used CO chondrites because they have metal-sulfide grains and sufficient amount of matrix, which may preserve spherical metal-sulfide grains. The samples were previously imaged by an industrial X-ray CT scanner (ELESCAN) to choose grains suitable for further work. Rods of about 4 mm in diameter, which includes such grains, were cut out and imaged at beamline BL20B2 of SPring-8 using micro-tomography system (SP-μCT: Uesugi et al., 1999) with the spatial resolution of about 13 μm. Metal, sulfide and silicates can be distinguished in CT images. Most of chondrules were also identified as they were embedded in FeO-rich matrix. 3-D images of metal-sulfide grains and chondrules were made using image analysis technique (FIG.1a). After imaging, some samples were cut physically and observed under an SEM (FIG.1bc) to compare CT images.

Results and discussion: It was observed three-dimensionally that many chondrules are present on concavities of irregular metal-sulfide grains (FIG.1ab). Spherical metal-sulfide grains surrounded by matrix were also observed. These results strongly suggest that metal-sulfide chondrules were formed by melting of solid precursors as well as silicate chondrules and most of ductile metal-sulfide chondrules were deformed by rigid silicate chondrules at low temperatures. As we did not find any foliated structures in the chondrites, the deformation should occur during accretion as chondrites. We also observed a spherical metal-sulfide surrounded by silicate chondrules (FIG.1C) showing that a solidified metal-sulfide chondrule and molten silicate chondrules were collided with each other. This feature suggests recycling of metal-sulfide and silicate chondrule formation.

Reference: [1] Uesugi et al. (1999) *Proc. SPIE*, *3772*, 214-221.

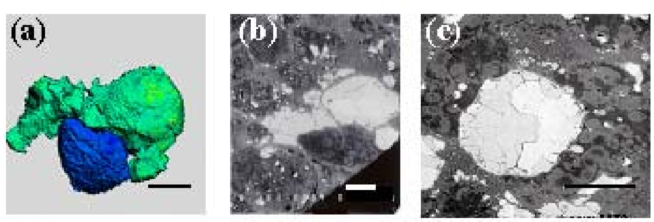

FIG. 1. A 3-D structure and SEM images of ALH-77003. (a) A spherical silicate chondrule enclosed by a partially irregular metal-sulfide grain. (b) A SEM image of (a). (c) A SEM image of a spherical metal-sulfide grain surrounded by deformed silicate chondrules (upper left and right). The metal-sulfide grain near the chondrules show reaction textures, while the surface in contact with matrix shows no reaction texture. All scale bars are 100 μm in length.