Electrical Discharge in Liquid Nitrogen for Particle Preparation

Yoon Sik Park [1], Dong-Wook Kim [2], Satoshi Kodama [1], and Hidetoshi Sekiguchi [1]

[1]Tokyo Institute of Technology, Japan

[2]Inha University, Korea, Republic of

The behaviors of electrical discharge process under liquid nitrogen and their effects on copper (Cu) particle formation have been investigated. In this study, spark transition to arc discharge was generated between Cu rod electrodes having flat plane immersed in a liquid nitrogen container. A Dewer-like beaker was used for the container to minimize liquid nitrogen evaporation during the experiment. The applied voltage and discharge gap were the variable parameters. A sample holder equipped with three-dimensional micrometer was used for delicate control of the Cu electrode gap distance. The electrical discharge properties such as waveform, discharge voltage and power were acquired with a digital oscilloscope. Synthesized Cu particles were characterized by transmission electron microscopy (TEM), selected area electron diffraction (SAED), field emission scanning electron microscopy (FE-SEM) and energy dispersive spectrometer (EDS) in order to investigate morphology and crystallite structure of particles. Surface properties of Cu electrodes were also analyzed using scanning electron microscopy (SEM) to study the effects of electrical discharge on electrodes. According to the FE-SEM and TEM images, spherical Cu particles of micro- to nano-size were observed. The SEM observation showed that the electrode surface was changed from flat plane to pore structure after the discharge. The interaction between the discharge and electrode as well as the mechanism of Cu particle formation were discussed.