

## **Production of Nanoscale Metal Powders by Electrical Explosion of Wire Process and Their Spark-Plasma Sintering**

**J.S. Kim, H.K. Lee, H.T. Kim, D.H. Kwon, B.P. Choi, and Y.S. Kwon**

School of Materials Science and Engineering, Research Center for Machine Parts and  
Materials Processing, University of Ulsan, Ulsan 680-749, Korea

e-mail: jskim@ulsan.ac.kr

The method of electrical explosion of wire (EEW) is known as one of the promising ways for production of nanoscale metal powders. In this study Al, Cu, Ni, Fe powders were produced by EEW and subsequent passivation process. Produced powders were characterized by particle size analysis, SEM- and TEM observation, oxygen analysis, XPS, and XRD. Relationship between process variables and powder characteristics are discussed.

Spark-Plasma Sintering (SPS) was used to investigate the densification behavior of nanoscale metal powders (Al, Cu, Ni, and Fe) during sintering process. SPS is well known to be very effective for the sintering of nanoscale or nanostructured materials. Possible reasons for the enhancement of densification during PECS process can be summarized as follows: (a) Electrical breakdown of surface oxide film and removal of contaminated layer on particle surface by spark generation and sputtering (surface cleaning effect), (b) destruction of surface oxide film and neck formation by local melting and evaporation of metallic region at the particle inside/oxide film interface, (c) focused current and Joule heat at the neck, (d) enhanced migration of atom or ion by temperature difference between neck and particle core (thermal diffusion effect) as well as by electrical field (field diffusion effect), and (e) plastic deformation by applied pressure. Experimental observation during the densification, possible densification mechanisms and the relationship between them are discussed.