Effect of Zinc Oxide Nano–particles Coated with Bi$_2$O$_3$
 on Microstructure of Varistors

Fangli Yuan  Hojin Ryu
Advanced Materials Division, Korea Reseach Institute of Chemical Technology,

1. Introduction
The bismuth–rich phase locating surround on ZnO grains is very important in the microstructure of varistors. In this paper, according to the function and location of Bi$_2$O$_3$, a new designed particle structure is reported, that is Bi$_2$O$_3$ layer was coated on the ZnO nanoparticles surface. It is speculated that this pre–designed structure can help to promote grains growth and a homogeneous bismuth–rich phase net production.

2. Experimental
ZnO nanoparticles coated with 1–5wt% Bi$_2$O$_3$ were prepared by conducting the precipitation of Bi(NO$_3$)$_3$ solution on the precursor of ZnO. Bi(NO$_3$)$_3$ and NH$_4$HCO$_3$ solution were dropped onto separate spots on the suspension of basic carbonate of zinc to obtain the Bi(OH)$_3$ precipitation. Varistors were made with these particles according to conventional process.

The morphology and particle size of zinc oxide were observed using TEM. The microstructure of the varistors was characterized using SEM.

3. Results
TEM shows that homogeneous Bi$_2$O$_3$ layer located on the ZnO particles. The particles are nearly spherical with size about 20 nm.

Microstructures of varistors show that ZnO grain is soaked in the homogeneous layer of Bi$_2$O$_3$ phase net. And with the increase of the Bi$_2$O$_3$, the thickness of Bi$_2$O$_3$ phase layer and the ZnO crystal particle size increase.