ATOMIC LEVEL CHARACTERIZATION OF NICKEL CRYSTALLITES OF NANOMETER DIMENSION

D. Kumar, H. Zhou, J. Narayan, G. Duscher, Andrew Lupini, S.J. Pennycook, A.V. Kvit and J. Sankar

Understanding the atomic structures and chemistry of nanoparticles and particle-host matrix interfaces is often critical to structure-property relationship in solid state structures of nanoscale dimension. In this paper we will be presenting our results from investigations in which scanning transmission electron microscopy with atomic number contrast (STEM-Z) and energy loss spectroscopy (EELS) were used to understand the atomic structure of Ni nanoparticles and interface between the nanoparticles and the surrounding matrices. Since Z-contrast imaging and EELS could be performed simultaneously, we were able to make direct correlations between structure and chemistry of the Ni nanoparticles which were embedded in amorphous alumina and crystalline TiN matrices using a pulsed-laser deposition process. It was interesting to learn from EELS measurements at individual grains and interface planes that Ni in alumina matrix does not from an ionic bond at the interface indicating the absence of metal-oxygen bond at interface. The absence of metal-oxygen bond, in turn, suggests the absence of any dead layer on Ni nanoparticles even in an oxide matrix.