Application of Automated Crystallography for Transmission Electron Microscopy (ACT) in Material Characterization

Chunfei Li
Department of Physics
Portland State University
Portland, OR

David B. Williams
Department of Materials Science and Engineering
Center for Advanced Materials and Nanotechnology
Lehigh University
Bethlehem, PA

Stimulated by the success of electron back scattering diffraction (EBSD), an alternative approach based on dark field imaging in transmission electron microscopy (TEM) has been developed and released by TSL/EDAX. The system is called "Automated Crystallography for TEM (ACT)." This system is expected to provide material information such as grain size, orientation, and misorientation between neighboring grains in a higher resolution than EBSD.

In this presentation, ACT will be illustrated by results obtained on an alloy of Cu0.98Sb0.02 (in weight percent). The effectiveness of ACT will be demonstrated by relating the results of crystallography to elemental analysis of grain boundary performed with x-ray mapping (XRM) in a scanning transmission electron microscope (STEM). STEM-XRM illustrates that Sb segregates to the grain boundary and the degree of segregation is not homogeneous. The same grain boundaries were studied by ACT, and their structures were described in term of angle/axis pair. It is shown that boundaries with low rotation angles show less segregation.

Further, a newly discovered potential of ACT that was not included in the original system development will be revealed and discussed. It is based on the observation that at certain beam positions areas near the grain boundary show strong bright contrasts in the dark field images recorded in ACT. This phenomenon is explained as the double-diffraction effect and may be used to measure grain overlapping along a thin film surface normal direction.