SURFACE ANALYSIS BY ATOM PROBE TOMOGRAPHY

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In order to obtain reliable data from the conventional and three-dimensional atom probes, the methods used to produce sharp needle-shaped specimens should not produce artifacts. The most common method of specimen preparation is electropolishing. In electropolishing, redeposition of selective ions from the electrolyte onto the surface may occur, thereby producing a non-representative surface layer. The alternative methods of conventional ion milling or focussed ion beam (FIB) milling also produce surface artifacts. These milling techniques produce damage to the surface and the implantation of atoms from the ion beam or from the specimen surface into the subsurface region of the specimen. In some cases, damage to the microstructure and amorphorization may also occur. Other types of films may be formed on the surface after the specimen preparation process. For example, a hydrocarbon layer may be deposited onto the surface during examination in the transmission electron microscope.

The extents and compositions of these surface films may be determined by atom probe tomography. In order to analyze the surface of the specimen, the three-dimensional atom probe is operated in a ramped mode similar to that which was developed by Panitz for the imaging atom probe. In this mode, no field ion microscopy is performed on the specimen prior to analysis. The specimen is pointed at the single atom detector and the voltages on the specimen are increased automatically from the minimum levels required to operate the timing system by the control program until atoms are field evaporated from the specimen. The three-dimensional dataset is then accumulated in the normal manner. Several examples of these artifacts will be presented. These results clearly reveal that the surface layers of an analysis are often not representative of the specimen. This method may also be applied to the study of surface oxidation or contamination. The information determined in this method may also be used to investigate artifacts in thin film specimens used in the transmission electron microscope.

Research at the Oak Ridge National Laboratory ShaRE User Facility was sponsored by the Division of Materials Sciences, U.S. Department of Energy, under Contract DE-AC05-000R22725 with UT-Battelle, LLC and through the SHaRE Program under contract DE-AC05-76OR00033 with Oak Ridge Associated Universities.