3DAP Data Acquisition

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A three-dimensional atom probe (3DAP) consists of an extremely sharp, needle-shaped specimen and a time-of-flight mass spectrometer equipped with a position-sensitive detector that is able to detect single atoms. Several different types of position-sensitive detectors have been used, including CCD cameras, wedge-and-strip anodes, multianodes, and combinations thereof. The surface atoms of a cryogenically cooled specimen are individually ionized by the superposition of a short (10 ns), high-voltage pulse onto the standing voltage on the specimen. These ions are then radially projected from the specimen toward a position-sensitive detector. The specimen surface is magnified by a factor of ~5 million at the single-atom detector. The position-sensitive detector provides the x and y coordinates of each field evaporated atom. The z coordinate is determined from the order in which the atoms are detected. This sequential atom-by-atom evaporation results in a volume of analysis. The identities of the field evaporated ions are determined from their flight times in the mass spectrometer. The mass spectrometer has sufficient mass-resolving power to distinguish the individual isotopes of all elements. In this tutorial, details of the instrument and its key components together with the methods of data acquisition will be presented. In addition, the selection of the experimental factors required to perform an accurate analysis will be discussed.

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-AC05-96OR22464 with Lockheed Martin Energy Research Corporation.