

Advanced Characterization of Materials at Micro-, Nano- and Atomic Scale

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Atom Probe Tomography

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Abstract

There are few materials characterization techniques that visualize individual atoms – let alone isotopes – that make up the nanostructures which ultimately influence materials properties. Atom Probe Tomography (APT) is the distinctive technique, which results in ‘atom maps’: displaying a particular volume of material in 3-dimensions, atom-by-atom. The technique, more descriptively named point-projection Time-of-Flight Mass Spectrometry, chemically identifies and localizes isotope positions in 3-dimensions and thereby myriad nanostructures, dopants, and clustering phenomena can readily be quantified.

After an introduction with a brief historical perspective, an overview of this characterization technique will be given. The description of how specimens are prepared for their analysis, the raw data collection, and evaluation methods of the data will be discussed. Predominant & typical applications of Atom Probe Tomography are metals, semiconductors, minerals, and some oxides. Specific examples will be provided of grain boundaries and nanometer scale precipitates in alloys, quantum wells and other semiconducting structures.

The application space of Atom Probe, however, is still expanding and with

cryo-transfer developments (initiated at ETH), the ability to measure dynamic materials – such as hydrogen or other solutes in alloys (and ultimately liquids) – enables softer materials to be interrogated. Examples of these initiating results will also be presented to demonstrate the up-and-coming capabilities of APT, enabling nano- and atomic-scale characterization of materials.