Nanoscale Analysis with the ORNL Local Electrode Atom Probe

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The commercial introduction of the local electrode atom probe (LEAP®) by Imago Scientific Instruments, Inc. in June 2003 has dramatically improved atom probe tomography. As the data acquisition rate of this new instrument is over ~300 times faster than previous types of three-dimensional atom probes, experiments may routinely be performed in minutes rather than days. The advantage of the local electrode configuration is that significantly lower voltages are required to produce the field strength required to field evaporate ions from the specimen. High speed (250 kHz) pulse generators coupled with crossed delay line detectors have enabled significantly faster data acquisition rates to be achieved. As the detector can be positioned close to the specimen, a large proportion of the specimen may also be analyzed. Data sets containing up to 10^8 atoms may be collected in the LEAP®.

Examples of the fine scale decomposition that occurred in several different types of materials will be presented. The microstructures of several neutron-irradaitated pressure vessel steels and model alloys have been characterized to investigate the influence of high nickel levels on the formation of copper-enriched precipitates and other second phases. A systematic study has been conducted on the decomposition of a $Pd_{40}Ni_{40}P_{20}$ bulk metallic glass during isothermal annealing between the glass transition temperature, T_g, and the onset of crystallization temperature, T_x. The partitioning of alloying elements between the phases in several nickel base superalloys has been characterized.

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