

## Introduction: A Special Issue on Nanoscale Characterization Using Atom Probe Field Ion Microscopy

While searching the internet for “nanotechnology,” I was not surprised to find many definitions. Two of these are as follows: (1) nanotechnology is the development and use of devices that have a size of only a few nanometers; and (2) nanotechnology can best be considered as a “catch-all” description of activities at the level of atoms and molecules that have applications in the real world. While nanotechnology is usually focused on the *building* of structures at the atomic scale, the *characterization* of such structures should also be considered as nanotechnology. At the Microscopy and Microanalysis 2002 Meeting in Quebec City, together with Tom Kelly and Mike Thompson, I organized a symposium entitled “Advances in Nanoscale Technology.” The response to this symposium was impressive, with 32 contributed and 7 invited presentations. Some of these presentations concentrated on atom probe field ion microscopy and form the basis for the invited contributions in this special issue of *Microscopy and Microanalysis*.

The atom probe field ion microscope was developed over 35 years ago at the Pennsylvania State University by Prof. E.W. Müller and coworkers. Almost 20 years later, the three-dimensional atom probe (3DAP) was developed, which allowed the position and chemical identity of the majority of individual atoms in a small volume of material (typically ~30 nm by ~30 nm by ~100 nm) to be mapped (for further details see *Atom Probe Field Ion Microscopy*, M.K. Miller et al., Oxford University Press, 1996). In the past 15 years, the 3DAP technique has been advanced (in both instrumentation development and materials science applications) by various research groups around the world, including those at the Université de Rouen (France), the National Institute for Materials Science (Japan), the University of Oxford (UK), Chalmers University of Technology (Sweden), Northwestern University (USA), and the Oak Ridge National Laboratory (USA). The 3DAP has been applied to a wide variety of materials science studies including phase transformations, precipitation, segregation, and atomic clustering. This issue provides a sampling of the recent contributions of the 3DAP technique to the characterization of nanoscale structures in different materials systems including steels, superalloys, aluminum-based alloys, and multilayer magnetic thin films. There are also papers on the advancement of instrumentation and data manipulation techniques.

As nanotechnology continues to advance, so must the characterization techniques used to tell the “builders” what they have fabricated. It is the responsibility of the microscopy community to develop and implement the techniques that make this feedback possible. It is fortuitous that the characteristic length of structures characterized in the 3DAP and those fabricated in nanotechnology are similar. Due to its capability to characterize small structures atom by atom, the 3DAP is a powerful tool able to assist and accelerate the advances currently taking place in nanotechnology. I hope this issue provides the reader with a useful overview of the application of atom probe field ion microscopy to the nanoscale analysis of materials and that these papers stimulate future applications.

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