Atom Probe Tomography Focus Topic
Room: Hall D - Session AP-ThP

Atom Probe Tomography Poster Session

AP-ThP1 Nanoscale Semiconductor and Oxide Characterization using Atom Probe Tomography, ***David Larson**, M. Ulfig, D. Lenz, D. Lawrence, D. Olson, D.A. Reinhard, T.J. Prosa, P.H. Clifton, T.F. Kelly*, CAMECA Instruments Inc.

Atom probe tomography (APT) is being used for an ever widening range of applications [1-3] and is now used by the majority of the leading semiconductor manufactures around the world for research and development [4]. The recent adoption of APT in studying complex semiconductor devices is driven by a combination of the need for nanoscale 3D dopant characterization [5] as well as the concurrent advances in sample preparation methods and advanced control of commercial APT systems [3]. Recent years have seen continued improvements such as flexible data acquisition control, signal-to-noise ratio improvement, compositional accuracy, and yield through improved control of software and hardware.

Yield in APT is often a limitation in extending the technique to non-traditional, material systems. Advanced proportional, integral, differential (PID) control algorithms have been developed to allow stable data collection at lower rates with very fast response times. This feature enables data collection at more optimal conditions to promote higher yield. Additionally, in laser mode, keeping the focussed laser spot optimally aligned with specimen apex is critical to both yield and data quality. Adaptive scan and focus algorithms with smart PID control have been shown to be especially useful in low data collection rate modes to acheive improved yield and accommodate changing environmental conditions. Examples of these advances will be shown.

The nature of APT requires that the entire region of interest (ROI) be captured within a volume roughly 200nm on a side. As applications of APT have expanded, analyses are often limited by the capability to isolate a given region within the bounds of an APT sample geometry. Recently, preparation techniques which allow for re-orientation and isolation of highly discreet ROIs have been developed. These techniques use a focused ion beam system to create markers (in this case holes) in a sample which delineate a specific region. Using this method (known as “targeted backside preparation” [6]), the region of interest is subsequently positioned in a specimen apex in a reversed orientation. This method improves often yield in many difficult materials cases, such as single device analysis or failure analysis.

[1] T.F. Kelly, D.J. Larson, Annual Reviews of Materials Research, **42** (2012) p. 1.

[2] E. A. Marquis *et al*, Current Opinions in Solid State and Materials Science 17 (2013) p. 217.

[3] D.J. Larson *et al*, “Local Electrode Atom Probe Tomography”, (Springer Science+Business Media,

New York) 2013.

[4] McClean Report, IC insights **17** (2013).

[5] http://public.itrs.net/ .

[6] D. Lawrence *et al*, 7th Annual FIB SEM Workshop (2014).

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