Atom Probe Tomography of Commercial Devices

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For the nanoelectronics industries, atom probe tomography (APT) looms large for the unique capabilities it offers for device characterization. The advantages of APT for analysis of a 3D device include; a) atomic-scale three-dimensional compositional mapping of a relevant volume (>10^6 nm^3), b) high detection efficiency (>50%), and c) high sensitivity (down to single atoms) for device analysis. These advances in applications have been made possible by major developments in instrumentation [1], specimen preparation [2], and often by methods correlation with TEM [3] or SIMS [4] or both [5].

Nonetheless, the cost of ownership and the spatial fidelity of complex structures have been cited as topics with the potential to impede widespread adoption. The cost depends on ease of specimen preparation of site-specific structures and the yield of quality analyses from these specimens. We will report on progress made in making routine analyses from off-the-shelf die structures of individual transistors. FIB deprocessing and preparation is used to create quality specimens in a few hours (Figures 1 and 2). Recent advances in laser instrumentation have improved the yield of quality data from these specimens (Figures 3 and 4). Recent developments in reconstruction algorithms have demonstrated fundamental improvements for multiphase nanoelectronic device structures. This presentation will highlight these results for generating cost-effective analyses for devices. The results demonstrate that APT is maturing for product research and development, process development, and failure analysis of device structures.

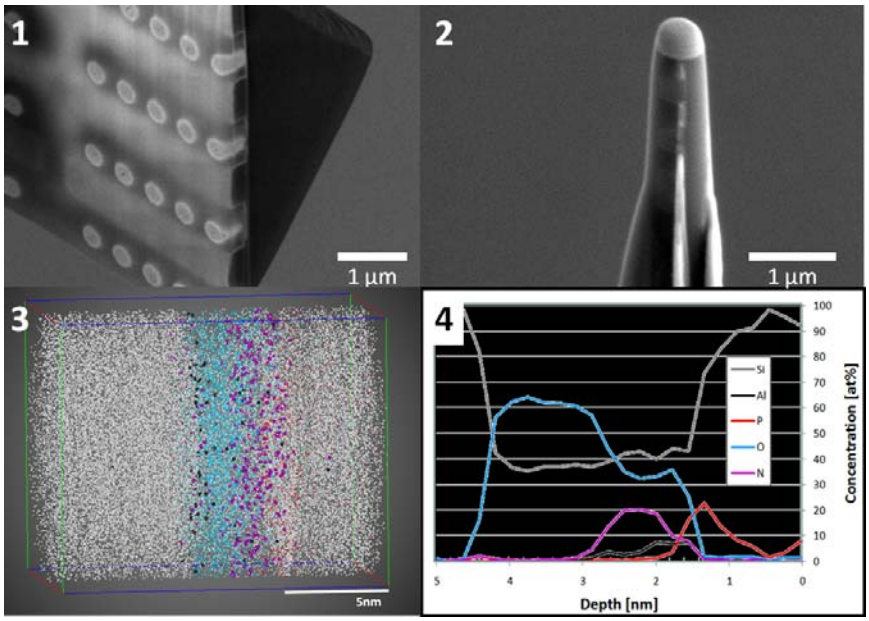

FIGURE 1. Device structure being deprocessed in FIB. **2.** APT specimen near final form. **3.** APT image of $SiON_x$ dielectric film. **4.** Composition profile through $SiON_x$ film of **3.**

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