doi:10.1017/S1431927622011849

Microsc. Microanal. 28 (Suppl 1), 2022

New Product Announcement – LEAP 6000XR, New Applications, New Performance

Robert Ulfig[1]*, Daniel Lenz[1], Gard Groth[1], Joseph H. Bunton[1], Isabel Martin[1], Ty J. Prosa[1], David A. Reinhard[1], Peter H. Clifton[1], Brian P. Geiser[1], and David J. Larson[1]

[1.] CAMECA Instruments Inc., Madison, WI, USA.
* Corresponding author: Robert.Ulfig@AMETEK.com

The goal of the Local Electrode Atom Probe (LEAP) 6000™ design was to build on the effectiveness of the local electrode compatible LEAP platform by improving the throughput and ease-of-use as well as to improve detection sensitivity, yield, and data quality. The LEAP 6000 achieves this by; 1) using improved cameras and vision systems providing automation with complete laser-specimen-electrode alignments, 2) more uniform heat deposition in laser pulsed mode from the new deep UV (DUV 257.5 nm wavelength) laser illumination which reduces the evaporation field differences (and resultant stress) between different phases for better reconstructions and yield, and 3) a synchronous voltage plus laser pulsing mode providing a better signal to noise ratio for many applications.

Mass spectral background noise reduction through the hybrid voltage plus laser pulsing mode is presented in Fig. 1a and Fig. 1b quantifies the up to 10X reduction in background noise levels for steel and silicon [1]. Improvement in mass spectral quality has been shown for a silicon dioxide and aluminum materials as well.

Evidence of how the DUV leads to improved yield is shown for the $Si-Si0_2$ system in Fig. 2a. The specimen in this analysis consists of a 12-nm silicon oxide layer between regions of silicon and the evaporation field (relative to silicon) for the DUV LEAP 6000 is up to 20% lower [2] in the oxide phase. These data are calculated directly from the specimen voltage. As the stress on the specimen is proportional to the electric field squared, a specimen illuminated with a DUV laser is under less stress and thus provides a higher probability to yield successful data [3]. Ongoing data collection has already statistically demonstrated higher success rates for the $Si-SiO_2$ system.

The high-resolution optical image and all of the automatically identified features in Fig. 2b enable fast and accurate recognition and placement of each specified microtip with respect to the electrode prior to starting an automated data collection recipe. Once data acquisition is started, the illumination of the data on the detector is used for final alignment. Fine alignment movements are typically on the order of three microns or less. These improvements together result in a substantial time-to-knowledge reduction and improved data quality for a wide variety of applications including microelectronics, metals, geological materials, and more.

References:

[1] T.F. Kelly, Micros Microanal. **17** (2011), p. 1.
[2] D.J. Larson et al., Micros. Microanal. **20** (2014), p. 2088.
[3] P.J. Birdseye, and D.A. Smith, Surf. Sci. **23** (1970), p. 198.

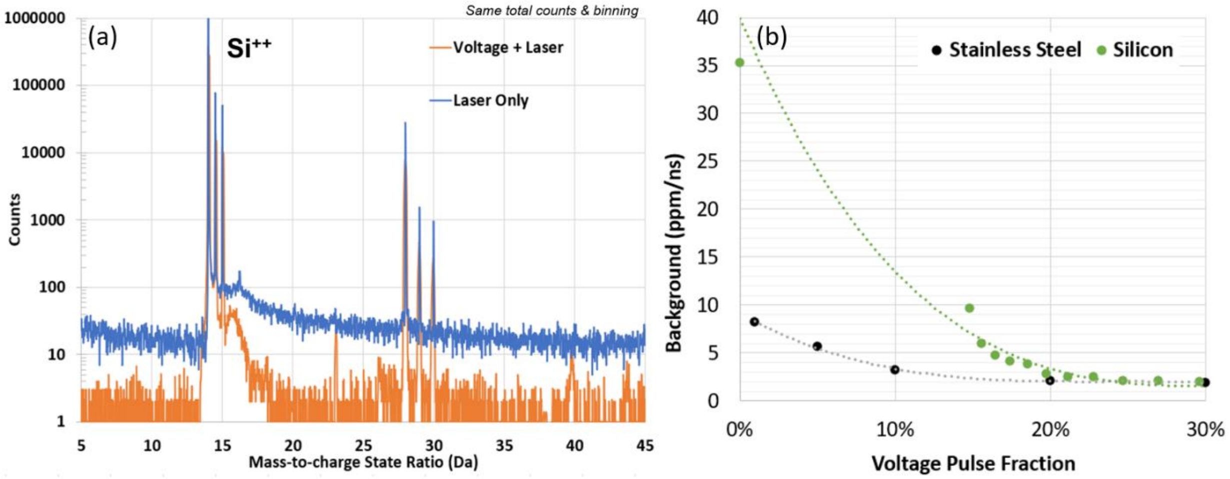

FIGURE 1. (a) Mass spectral background noise reduction through a combined voltage plus laser pulsing mode for silicon and (b) noise reduction as a function of voltage pulse fraction for silicon and a stainless steel.

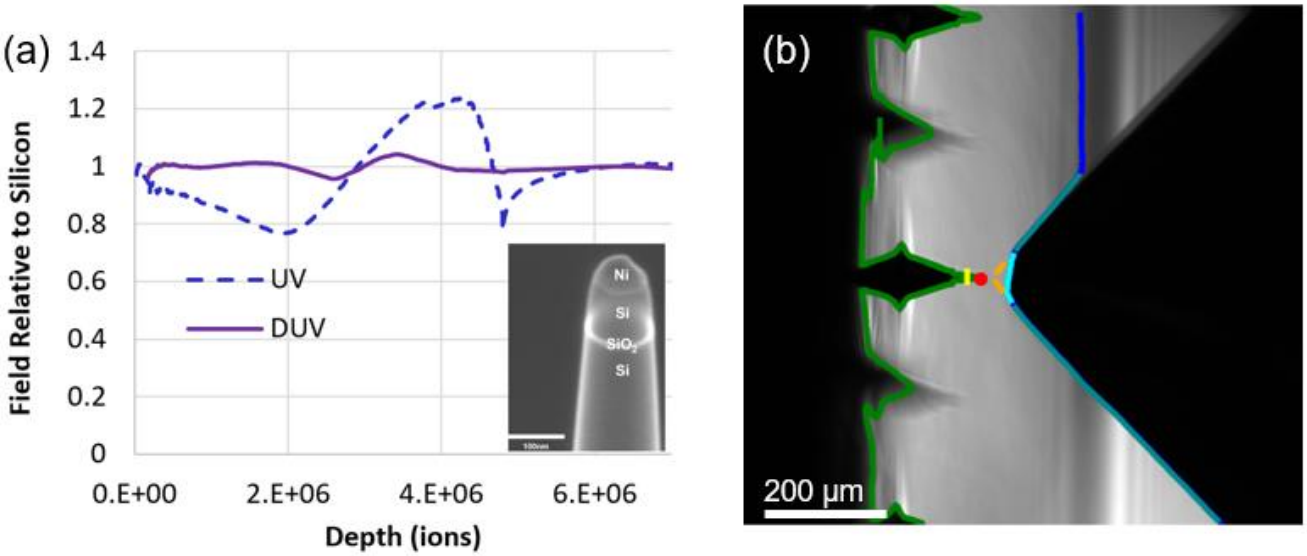

FIGURE 2. (a) The effective evaporation field (relative to silicon) for the UV and DUV cases when field evaporating through a silicon / silicon-oxide / silicon structure. The DUV laser provides improved yield in this system by reducing the effective stress on the specimen. (b) Machine vision used to place the apex of the microtip in a ready to run position. The green line is the automatically identified specimen contour while dark-greenish-blue is the electrode upper/lower surface contour, light blue is the aperture contour. The orange dotted lines are the estimate of where the upper/lower electrode contours would intersect, and the yellow line is where specimen focus is measured. Each of these features are used to move the calculate the closed-loop, motorized specimen stage so the specimen apex (red dot) is at a ready to start position.