Advances in 3D Atom probe: the LEAP 5000

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Atom probe tomography (APT) is based on time of flight (TOF) mass spectrometry of the atoms of a specimen prepared as a sharp needle. The atoms are extracted and ionized with high efficiency in a DC electrical field of a few tens V/nm. The combination of UV laser pulsing to initiate atom evaporation, and FIB-SEM technology to cut, extract and shape specimens from selected areas of bulk materials has revolutionized the technique, opening its application to new fields beyond metallurgy: dielectric materials, oxides and ceramics, microelectronics, spintronics, photovoltaics, LEDs and geology.

The LEAP 5000 is an evolution of the 3D atom probe; its unique design is based on the integration of a local electrode, a high frequency UV laser focused to a few µm spot size, and the choice between two types of TOF mass analyzers (linear or energy-compensating reflectron). Three main instrumental improvements will be reviewed and illustrated through applications:

1) increase of overall instrument transmission up to ~80% of atoms in the specimen;
2) increase of analysis repetition rate to 1 MHz in laser mode and 500 kHz in voltage mode. This results in faster acquisitions (or larger accessible volumes), higher success rate at lower evaporation flux, and better data quality in voltage mode;
3) redesign of the two available TOF mass analyzer ion optics.