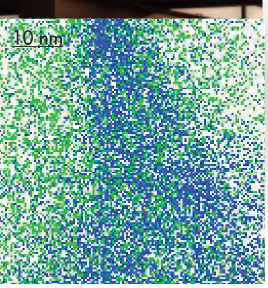
CAMECA®
SCIENCE & METROLOGY SOLUTIONS

EIKOS-UV™

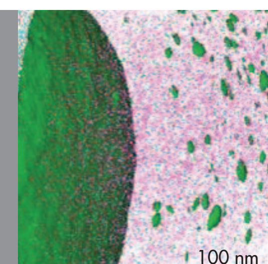
The Workhorse Atom Probe for Research and Industry



3D NANOSCALE TOMOGRAPHY

SINGLE ATOM DETECTION

QUANTITATIVE COMPOSITION ANALYSIS



AMETEK®
MATERIALS ANALYSIS DIVISION

Building on 30 years of success in Atom Probe Tomography (APT) instrumentation and application, CAMECA announces EIKOS-UV™, the Atom Probe Microscope that brings APT to the next generation of material scientists, metallurgists, physicists, geologists and engineers.

EIKOS-UV™: Accessible APT

The new EIKOS-UV™ provides excellent analytical performance from a platform optimized for both efficiency and simplicity of operation. EIKOS-UV™ delivers all of the benefits of APT - nanoscale characterization of materials with the best combination of high spatial resolution and detection sensitivity - in an easy to use, affordable package.

Key benefits

- Single atom detection with outstanding efficiency
- 3D tomographic data with near-atomic spatial resolution
- Equal sensitivity to all elements and their isotopes
- Quantitative composition measurement (sub-nm to micrometer scale)
- Broad application range includding metals, coatings, thin films, ceramics, minerals and functional materials
- Portfolio of mature specimen preparation methods for wide variety of materials
- Analysis software with wide range of analytical tools

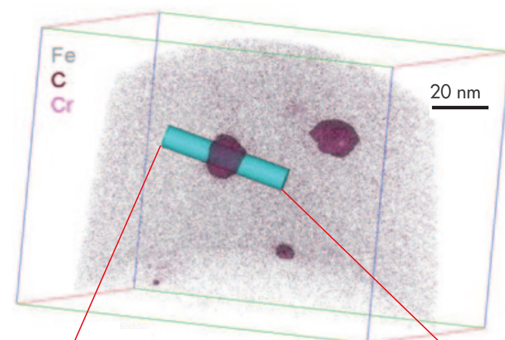
EIKOS-UV™ is available in two configurations

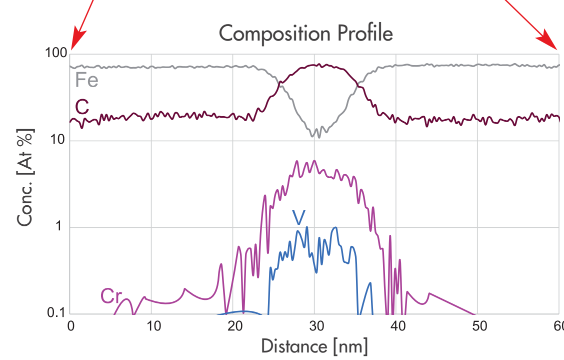
The base EIKOS™ system operates in voltage mode and incorporates a reflectron design to provide excellent mass resolving power and signal to noise. The voltage pulsing system provides exceptional data quality on a wide variety of metallurgical applications. A pre-aligned integrated counter electrode ensures ease of use and high reliability. The base EIKOS™ is field upgradable to the EIKOS-UV™.

The fully configured EIKOS-UV™ system combines all the outstanding features of the base EIKOS™ (voltage pulsed, reflectron based functionality) and adds UV laser capability to enable the comprehensive application range. The laser pulsing module features a focused spot design and fully automated alignment and control.

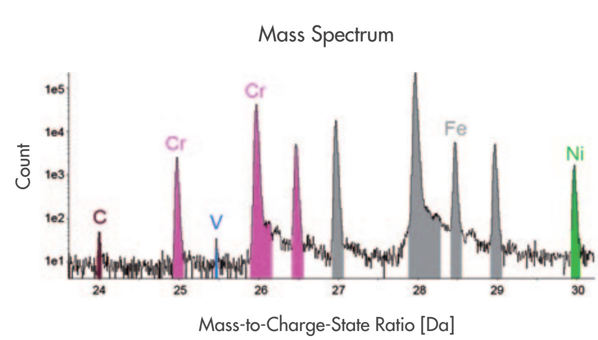
HIGH PERFORMANCE STEEL

Nanoscale 3D mapping clearly revealing the Molybdenum and Carbon rich precipitates that add strength and corrosion resistance to this alloy. Precipitates displayed by a concentration surface of 20% carbon.





Concentration profile through the nanoscale vanadium and molybendum rich chrome carbide – demonstrating detection, and quantification with nanoscale resolution.



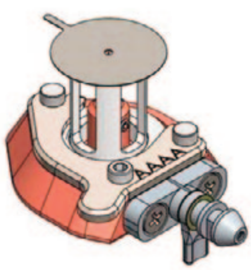
Mass spectrum demonstrating excellent trace element detection: e.g. vanadium in steel ~ 30ppm.

A new Atom Probe design ensuring ease of use in both academic and commercial environments.

The EIKOS-UV™ Atom Probe has been designed to maximize utility for the development of commercial alloys and advanced materials, as well as adoption within broad-ranging academic research. The powerful combination of performance, reliability and simplicity are made possible thanks to two major instrumental innovations.

Integrated counter electrode

The innovative prealigned counter electrode design eliminates the need for in-situ alignment. This effect eradicates the need for moving parts within the instrument directly enables the combination of simplicity and ease of use.



The new electrode design allows pre-alignement of the specimen tip to the counter electrode outside of the vacuum system. This novel technology simplifies the EIKOS-UV™ system and eliminates the need for consumables.

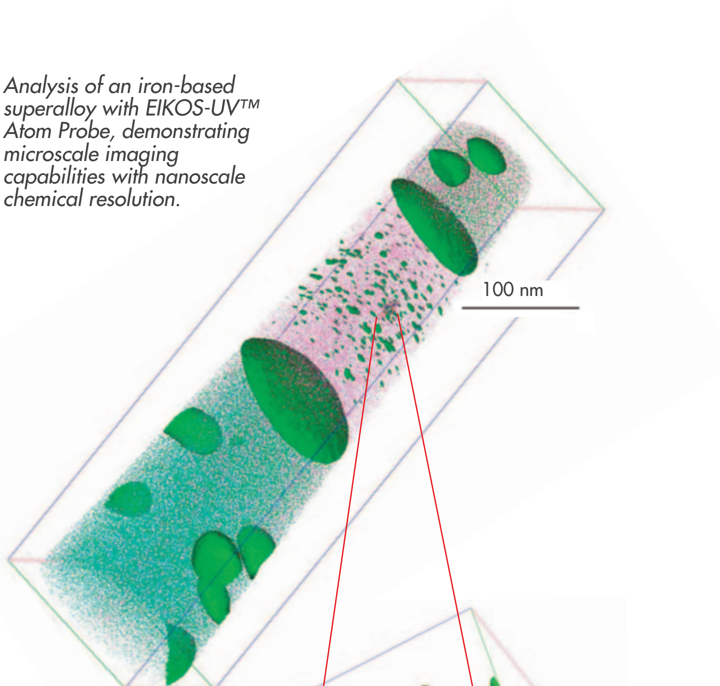
New 355 nm laser system

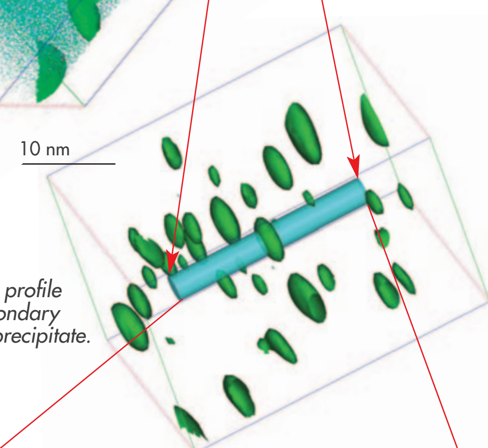
With its new 355 nm laser pulse system, CAMECA has put a premium on simplicity, from the reliability of the industrial grade hardware to the easy to use control interface integrated into the Atom Probe Control Center™ software. With the field upgradable laser module, the EIKOS-UV™ delivers 3D atomic scale data across a wider applications space.

A wide range of applications

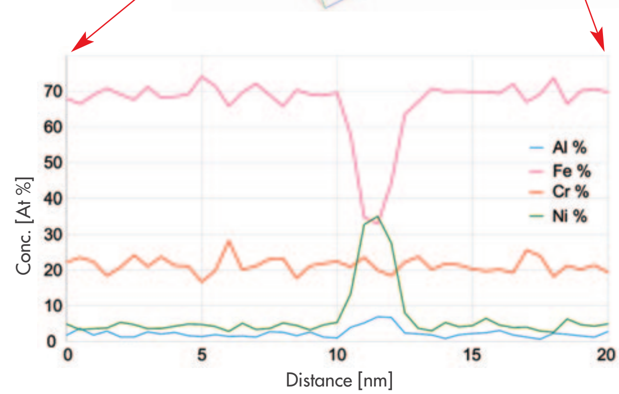
- Metals
- Coatings
- Thin Films
- Ceramics
- Minerals
- Functional Materials

Analysis of an iron-based superalloy with EIKOS-UV™ Atom Probe, demonstrating microscale imaging capabilities with nanoscale chemical resolution.





Concentration profile through a secondary alpha-phase precipitate.



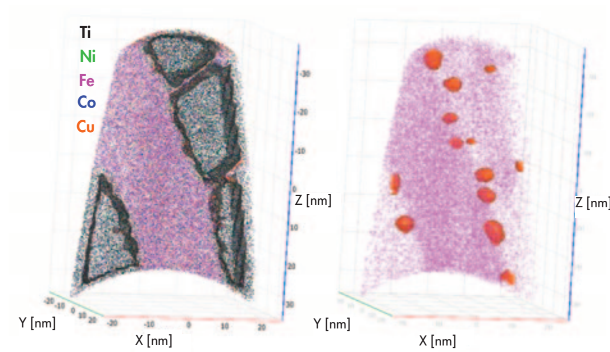
At least five chemically distinct phases are captured in this 3D dataset. The nanoscale chemical information allows a clear understanding of how processing and the resultant nostructure affect real-world performance properties – like the high creep resistance of this iron-based superalloy.

A selection of EIKOS-UV™ applications.

MAGNETIC ALLOY DEVELOPMENT

Understanding the micro and nano-structural evolution of permanent magnet AlNiCo alloys in response to operating conditions (e.g. high temperature) allows for better prediction of their magnetic properties.

The EIKOS-UV™ atom probe microscope is the perfect tool for characterizing and understanding these complex material systems. The combination of very high spatial resolution and detection sensitivity enables direct observation of all elements of the microstructure, and their evolution with respect to manufacturing or operating conditions.



Three-dimensional atom maps of a 10 nm slice of the AlNiCo alloy with (left) Ti/Ni/Fe/Co/Cu atoms displayed along with an iso-concentration surface highlighting regions greater than 12% Titanium ($\alpha 1$ phase) and at the right, the Fe rich $\alpha 2$ phase visible with regions greater than 8% copper highlighted with iso-surfaces that decorate the phase boundaries.

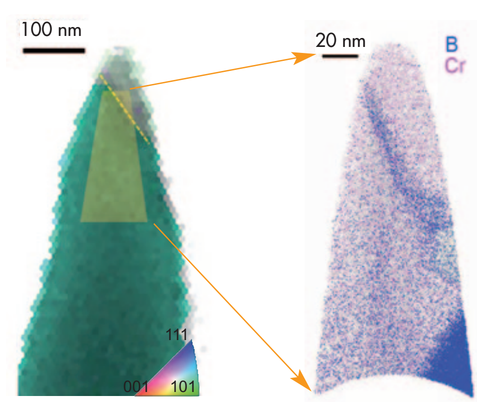
W. Guo et al. Microsc. Microanal. 22, 2016 doi:10.1017/S1431927616012496

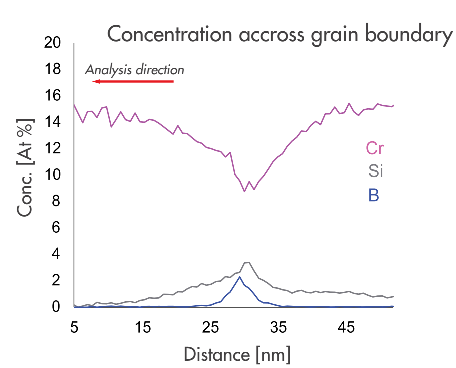
GRAIN BOUNDARY ENGINEERING

Advances in alloy development can be made greatly enhanced with the understanding that atom probe data provides about nanoscale segregation of solutes.

In the present example commercially available Inconel 600 alloy was analyzed with the EIKOS-UV™ atom probe. Strong boron segregation to the grain boundary was revealed.

EIKOS-UV™ provides unique information, which is sufficiently powerful to yield quantitative 3D subnanometer chemical information in and around the grain boundaries allowing a window into understanding how chemical segregation may affect the material's performance.





A transmission EBSD map of an Inconel 600 atom probe specimen with the APT analyzed volume overlaid and the resultant 3D data shown. A concentration profile across the targeted grain boundary showing B and Si enrichment as well as Cr depletion at the boundary.

K.P. Rice et al. Microsc. Microanal. 2016, 22(3), doi:10.1017/S1431927616011296

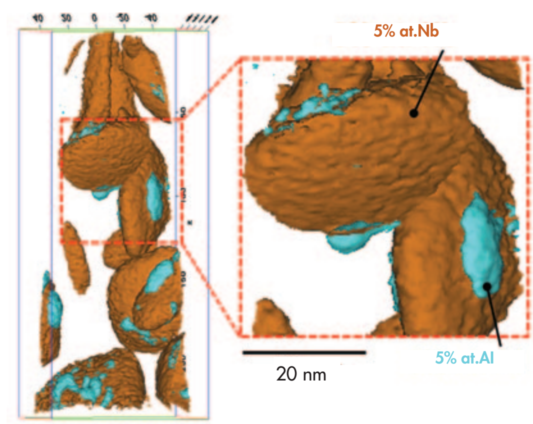
EIKOS-UV™ addresses a wide range of APT applications that have been demonstrated for over 30 years.

ADDITIVE MANUFACTURING

Additively manufactured (AM) materials, also known as 3D printed materials, are a rapidly growing class of materials due to their numerous processing advantages.

EIKOS-UV™ microscopes provide useful nanoscale information, such as clustering behavior of different chemical species and grain boundary segregation, that can be used to optimize processing conditions in order to achieve the optimal properties.

By correlating the microstructure and material performance to processing conditions, additive manufacturing methods can be quickly optimized.

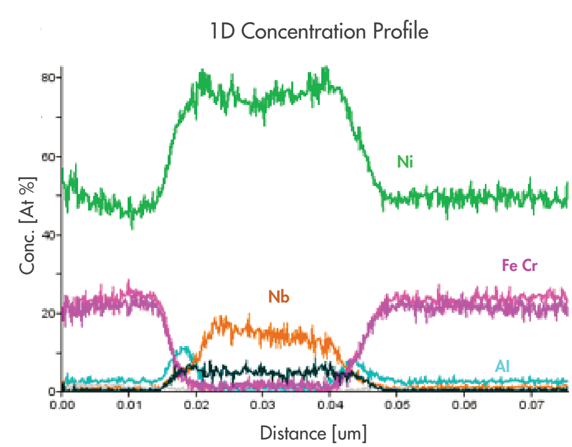


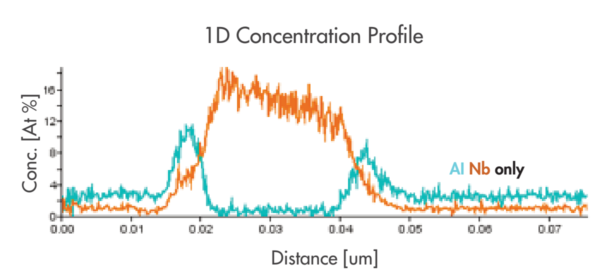
Clustering in AM Inconel

APT analysis reveals large titanium-niobium rich precipitates that were formed during the electron beam-assisted manufacturing process of Inconel 718. Aluminum is shown to form smaller precipitates on the flat surface of the large disc-shaped Nb precipitates as indicated by the isoconcentration surfaces.

The AM process includes multiple very rapid heating and cooling steps generating complex structures that can be beneficial or detrimental to the alloy performance.

D.J. Larson, et al. JOM 2018 70(S2), doi: 10.1007/s11837-018-2982-1





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AMETEK MATERIALS ANALYSIS DIVISION

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