

Hi5

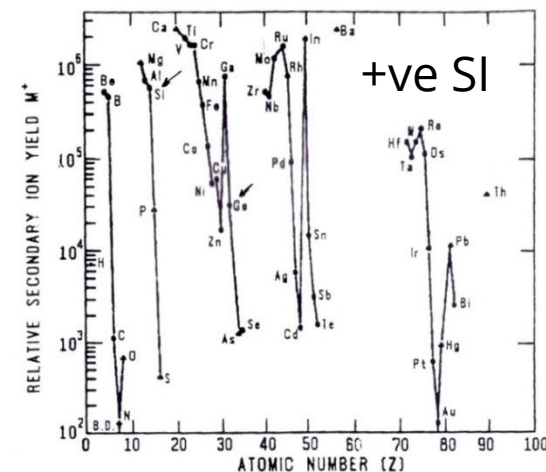
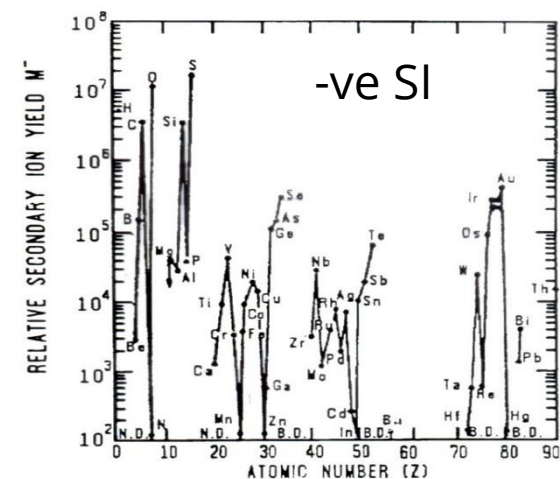
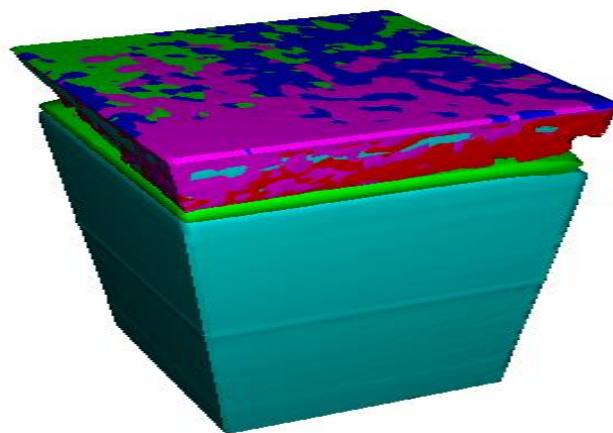
A New High Performance UHV SIMS Tool with
Simultaneous Positive and Negative SIMS Detection and
Plasma FIB

Why collect positive and negative ions simultaneously?

Often need to gather complimentary data with +ve and -ve secondary ions from an inhomogeneous sample (only one shot!)

Changing the extraction polarity will shift the primary ion beam and make registration difficult or impossible

Changing extraction polarity takes time



Taken from: SIMS Handbook ed : Wilson R.G.; Stevie, F.A.; Magee, C.W.; John Wiley & Sons Inc. NY 1989

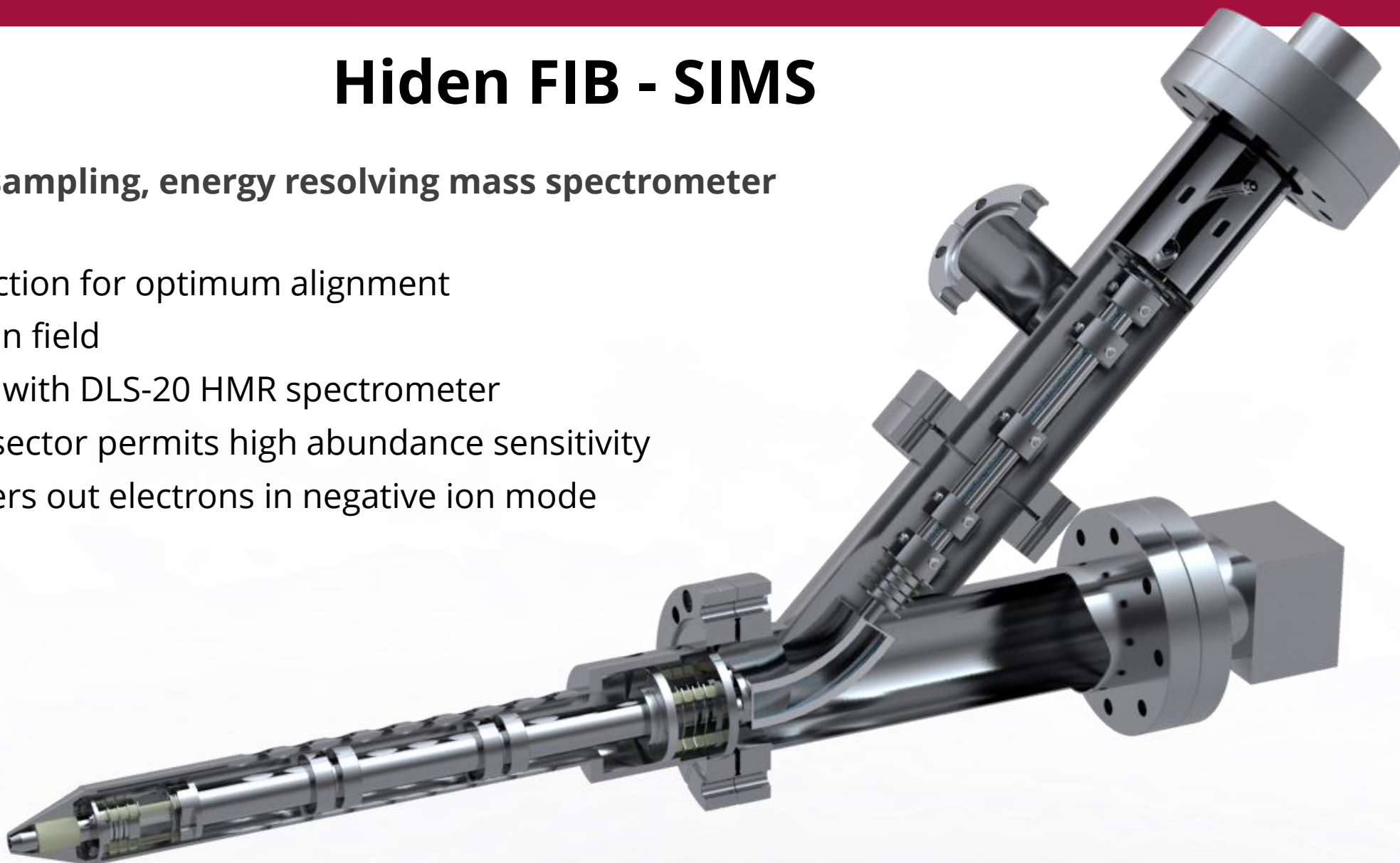
Hi5 Focused Ion Beam SIMS

- **Collect positive and negative secondary ions *simultaneously* with accurate registration of images / depth profiles**
 - Two quadrupole analysers with low field (~10V/mm) extraction field) in optimum geometry
- **Oxygen / inert gas primary beam (FIB) and Cs primary beam**
 - Plasma FIB ion gun – Oregon Physics Hyperion II (normal incidence)
 - Hiden IG5C Cs ion gun 45 degrees
- **5 axis high precision stage with sample heating / cooling and external electrical connections to operate devices during analysis.**
- **UHV vacuum performance (as interested in atmospheric species)**
- **Vibration isolated bed for 20nm resolution**
- **Ability to have high mass resolution to separate D₂ and He as Deuterium and oxygen-18 diffusion studies for fuel cell and metallurgy investigations.**

Hidden FIB - SIMS

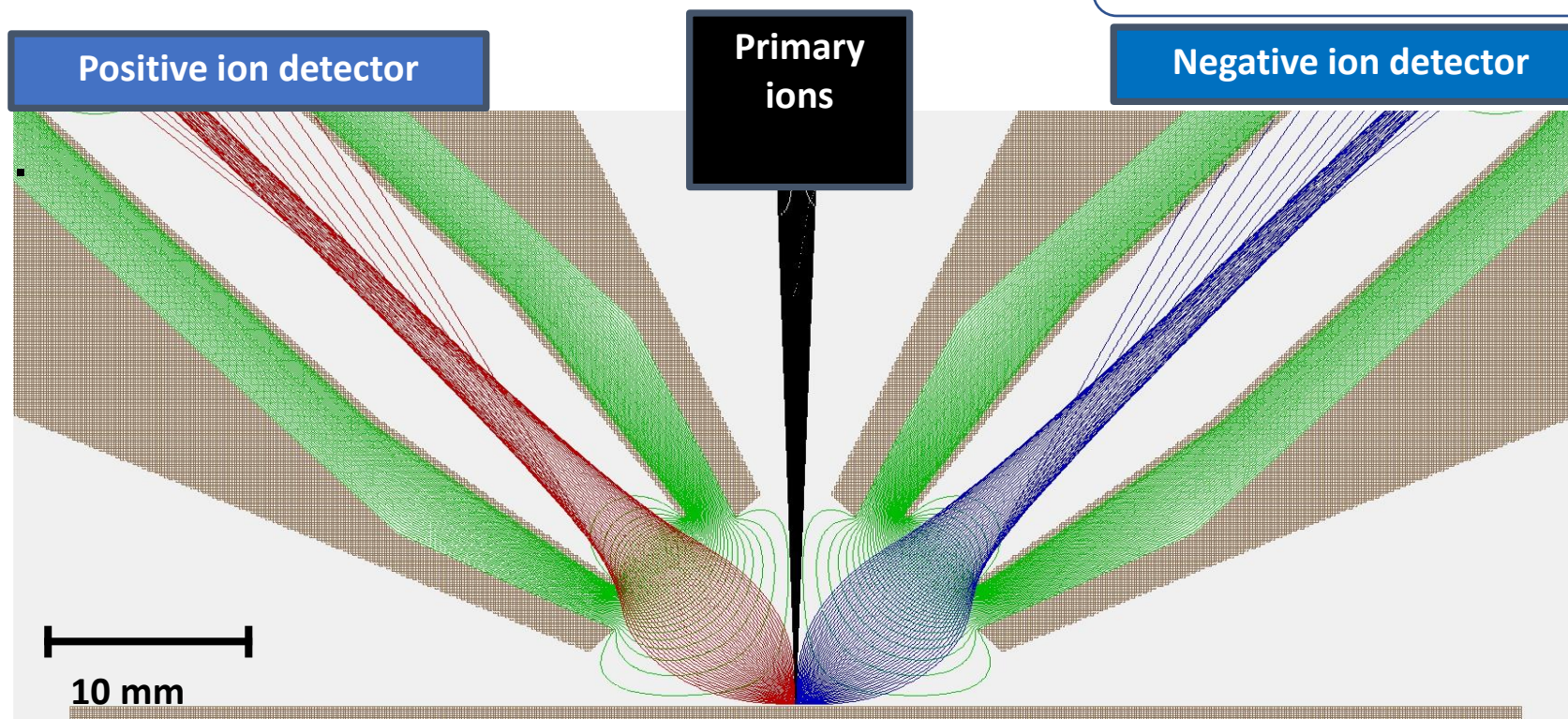
EQS – On-axis sampling, energy resolving mass spectrometer

- On-axis collection for optimum alignment
- Low extraction field
- Can be fitted with DLS-20 HMR spectrometer
- Efficient 45° sector permits high abundance sensitivity (1E6) and filters out electrons in negative ion mode



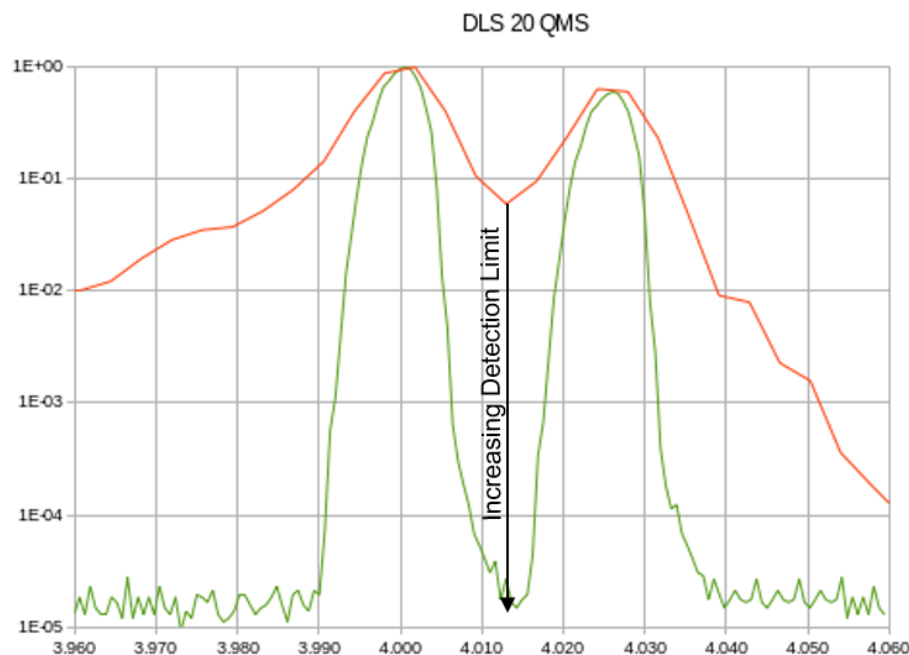
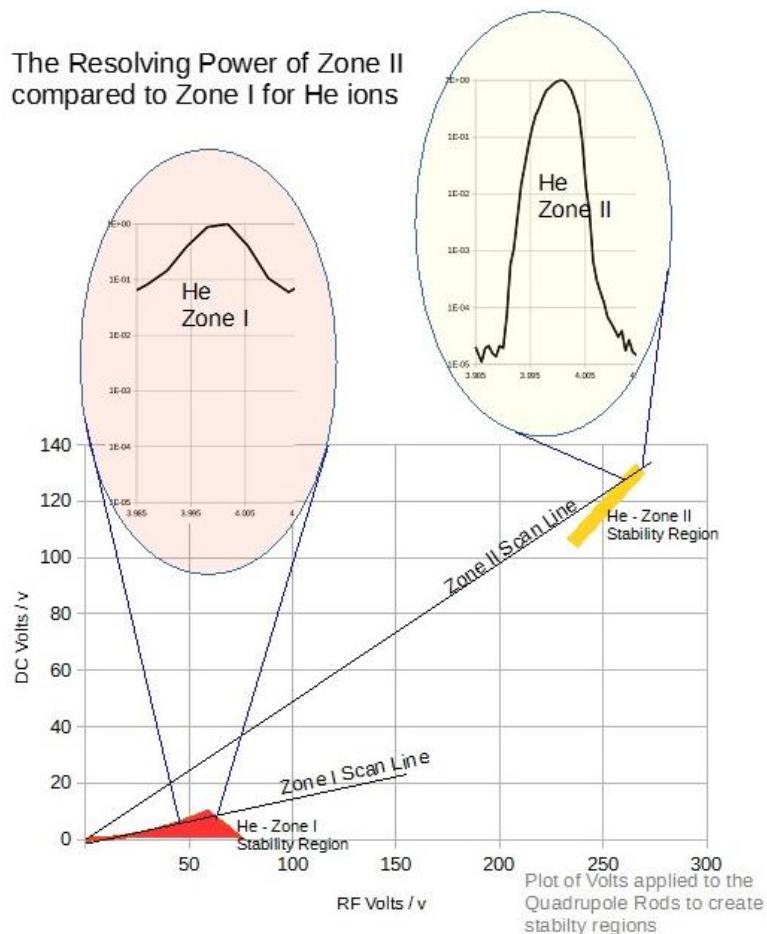
Hi5 Simultaneous Dual Polarity Detection FIB

- SIMION ray-tracing model of a configuration for Simultaneous Positive Negative secondary ion detection with two Hiden SIMS detectors
- Opposing balanced symmetrical fields enhance high collection efficiency
- Low extraction field (10V/mm) reduced primary beam aberrations
- Sputtering by a normally incident primary beam.



DLS-20 Mass Filter – 20mm pole diameter

Operates in both first and second stability region



Hi5 SIMS Instrument

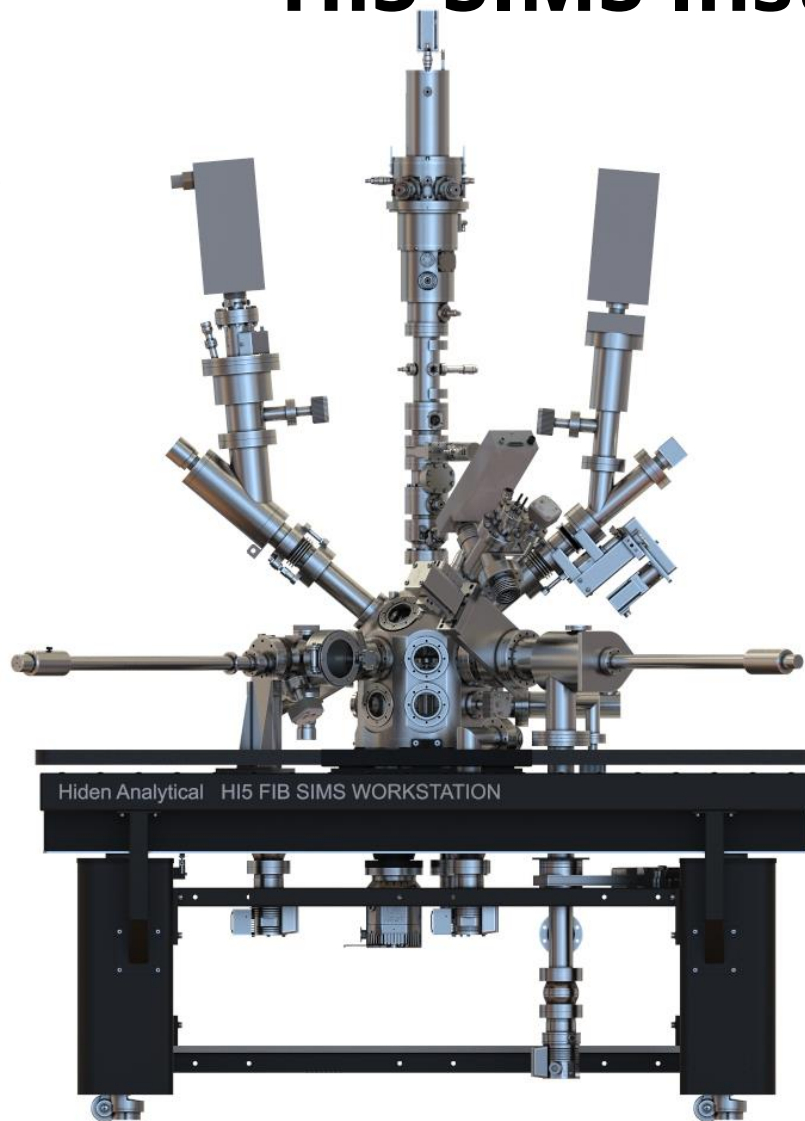
**20 mm HMR
quadrupole SIMS
analyser**

Charge
compensation
electron gun

Loadlock 1

UHV high
stability
chamber

5 axis stage



**9 mm
quadrupole
SIMS analyser**

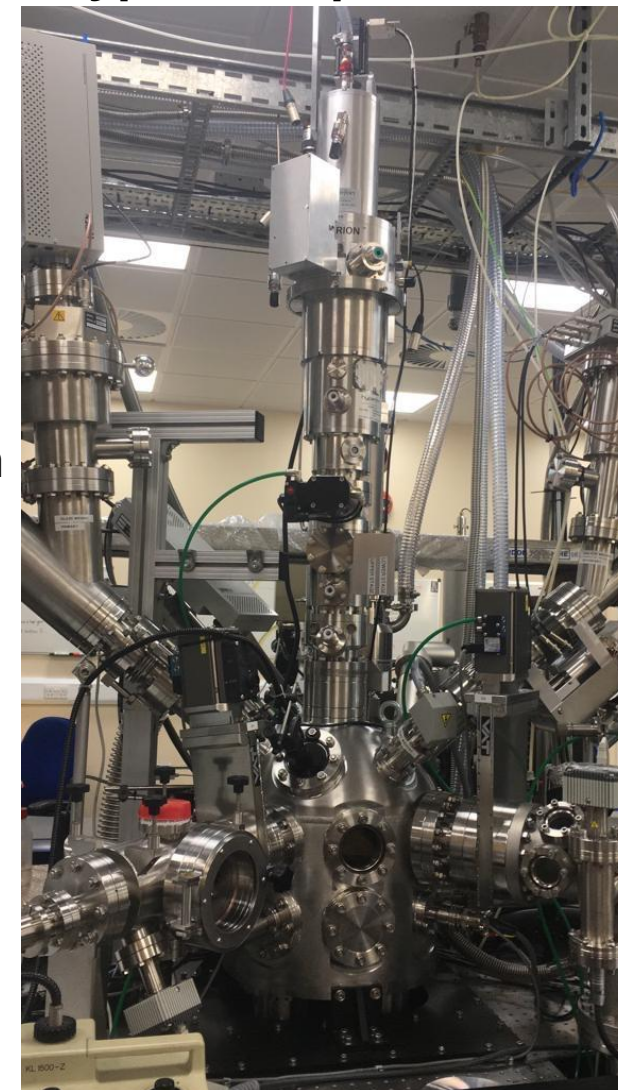
Secondary
Electron detector

IG5C caesium ion gun

Loadlock 2 and
process chamber

Anti-vibration table

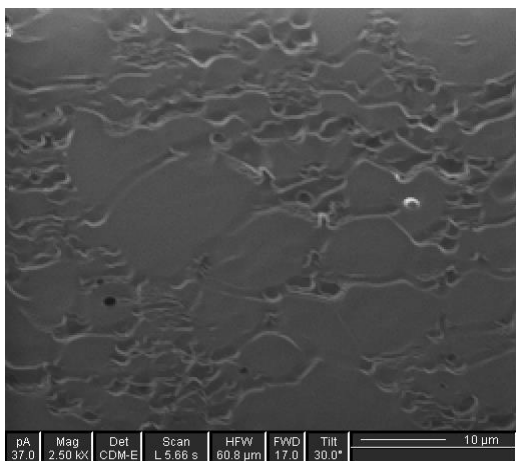
**Oregon Physics
Hyperion II plasma FIB**



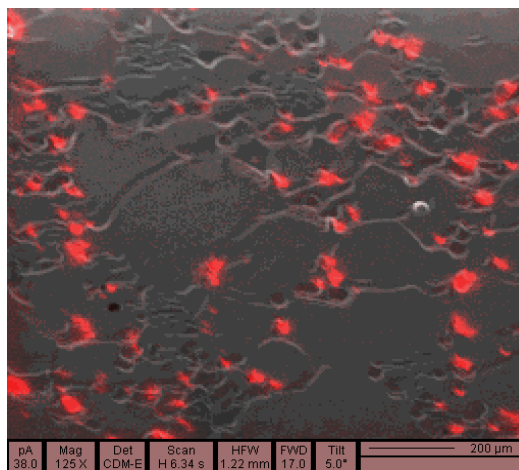
FIB-SIMS



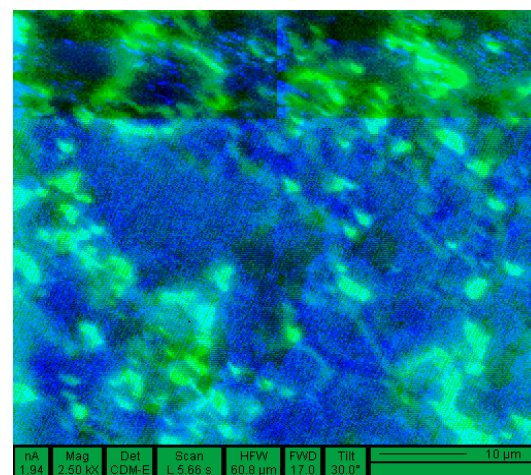
Al+ mapping region 3,
cleaned area 20 nA 5 min,
1.94 nA current; 200 nm
resolved area



Al+ in red; overlay (below)



LaO+ in blue; Li+ green
overlay



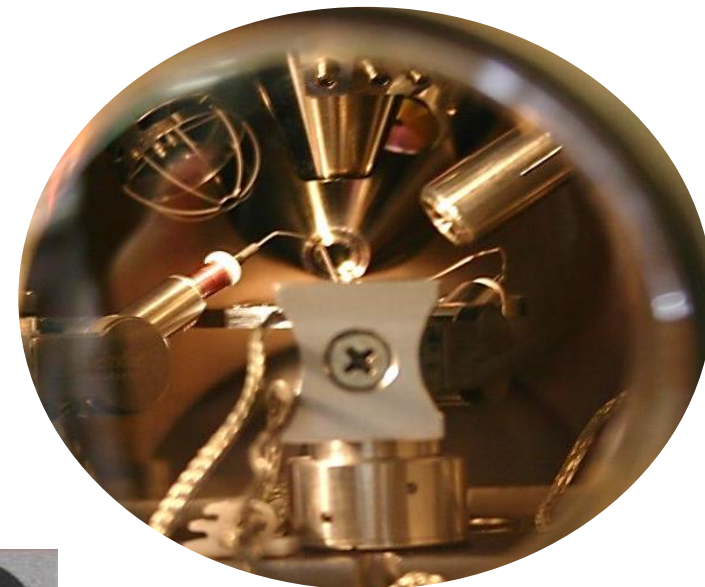
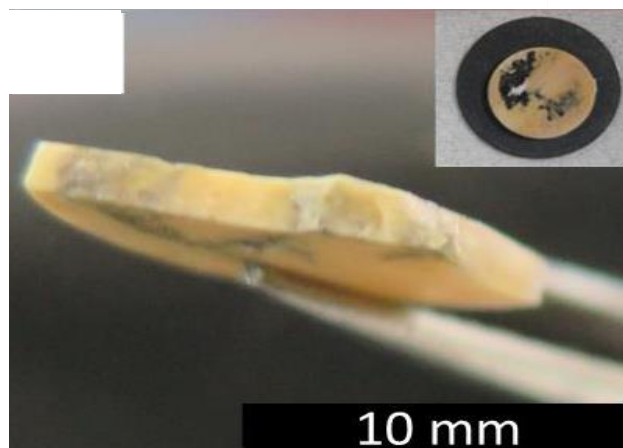
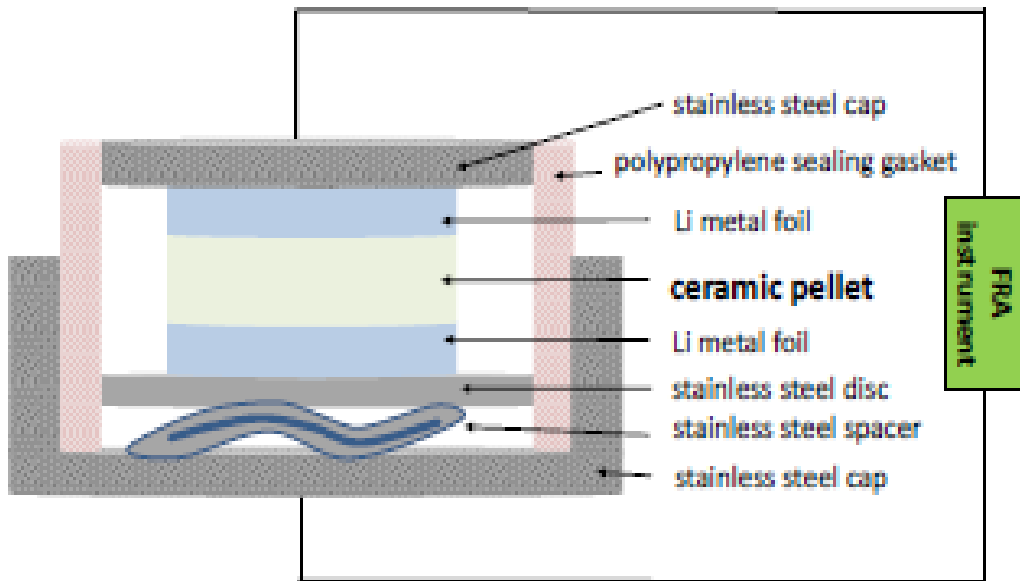
Non-homogeneous AL-distribution along the grain boundaries

Two distinct areas that are Li-rich:

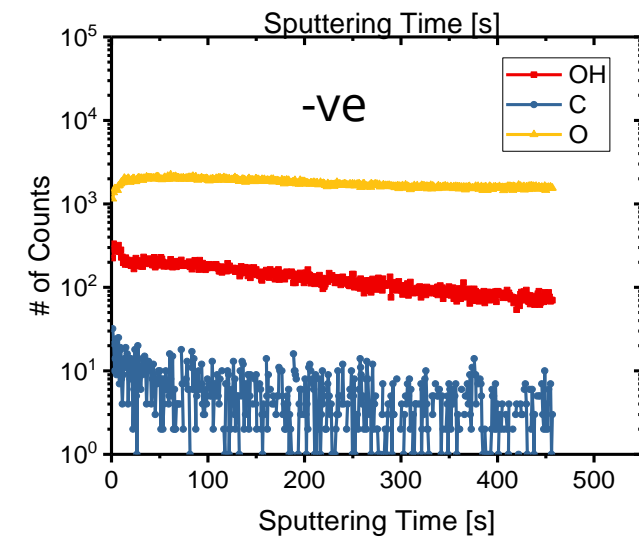
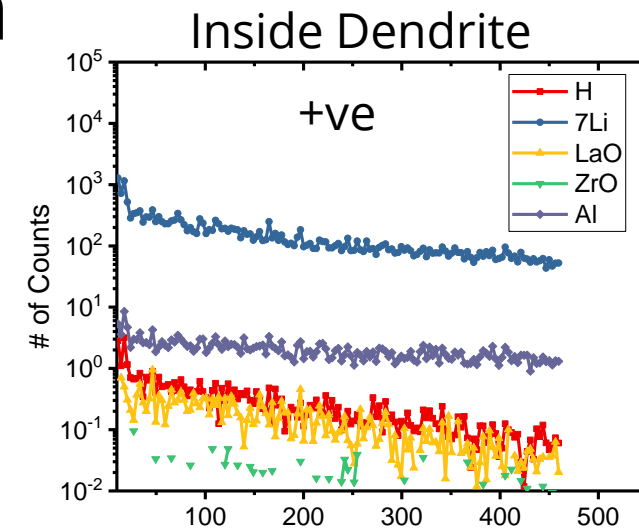
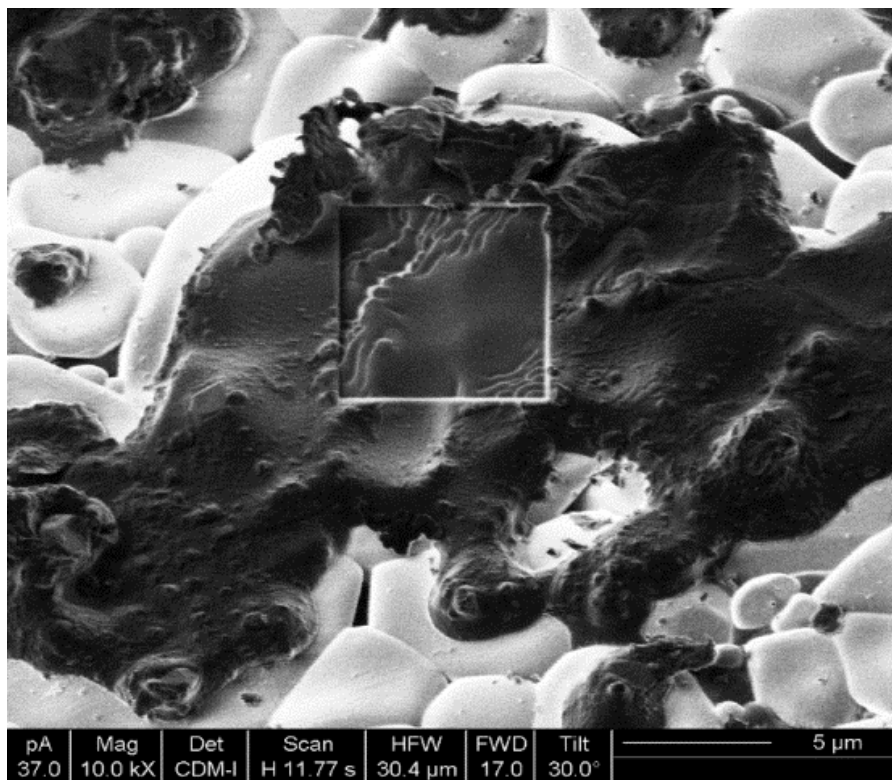
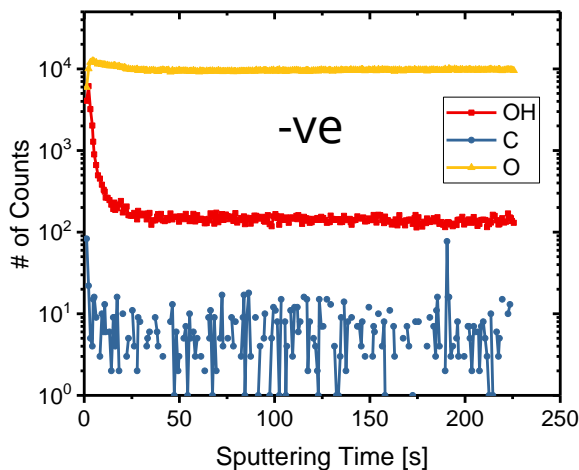
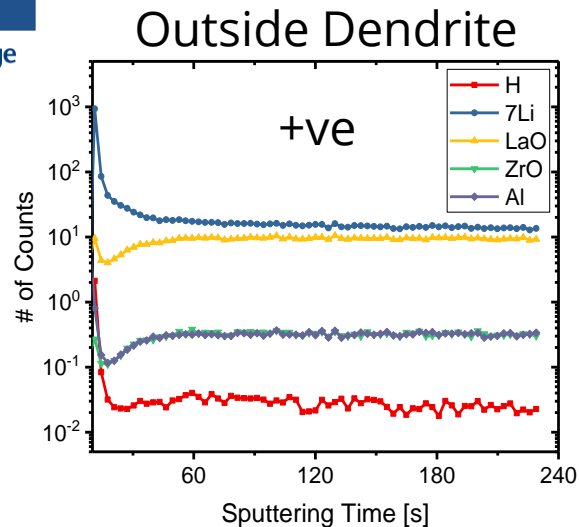
- 1) Associated to Al enrichment
- 2) Associated to Al and La depletion

Imperial College work with Dual Polarity Detection

Dendrite formation in solid electrolyte garnets $\text{Li}_{6.55}\text{Al}_{0.15-0.3}\text{La}_3\text{Zr}_2\text{O}_{12}$



Simultaneous Dual Polarity Secondary ion Detection



Summary

- Hiden Hi5 – first commercial simultaneous collection of positive and negative secondary ions
- Integration of plasma FIB using oxygen or xenon for highest sensitivity
- Five axis stage for accurate sample positioning
- UHV performance
- Multiple additional features such as heating and cooling, micro-manipulation and process chambers allow in-situ processing and analysis without leaving vacuum
- Delivered to Imperial College department of Materials

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- A photograph of a modern, two-story office building with a grey facade and large glass windows. The building has a prominent entrance on the left and a long row of windows on the right. A large, semi-transparent white circle is overlaid on the left side of the image, containing a bulleted list. The sky is clear blue, and there are some trees and bushes in the foreground.
- www.HidenAnalytical.com
 - The Hiden website is an excellent resource with product pages, brochures, catalogues, product pages with some application notes, presentation and other information.
 - Contact +44 1925 445225 for direct support.