NM-022 Atom Probe Tomography (APT)

I. System specification and Model:

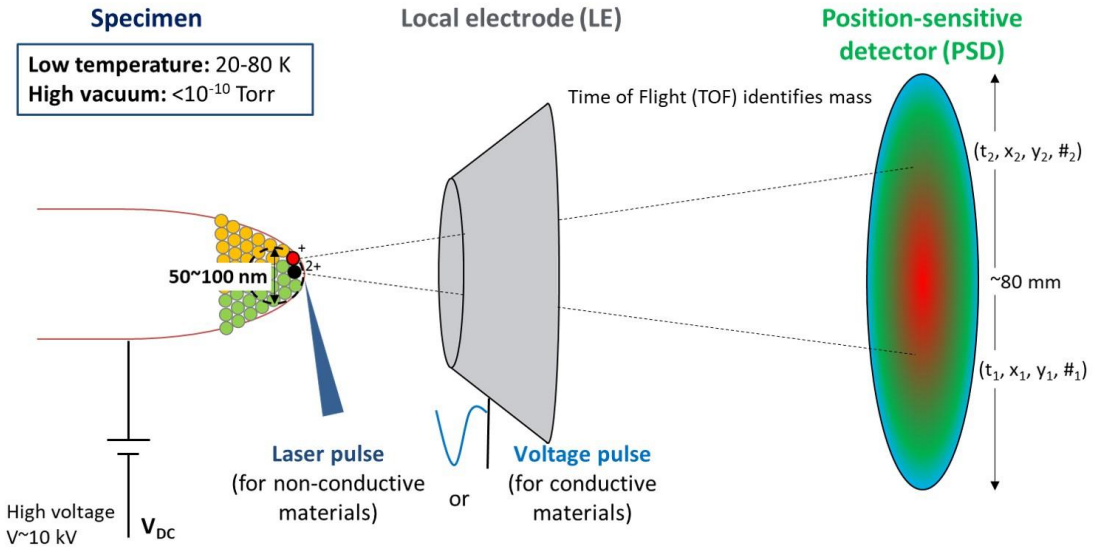
1. Model: CAMECA LEAP 5000 XR
2. Maximum voltage pulse frequency: 500 kHz
3. Mass resolution (FWHM): 1000
4. Laser wavelength: 355 nm
5. Laser pulse energy: 0.001 pJ-1000 pJ
6. Specimen temperature: 25-100 K
7. Vacuum: $<10^{-10}$ torr
8. Detection efficiency: 50%-60%

II. System appearance:

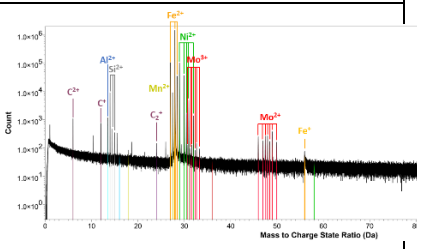
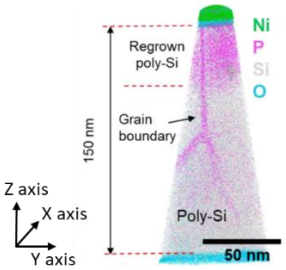
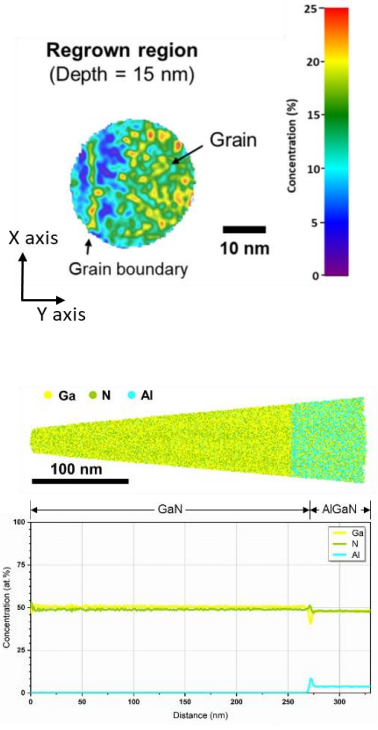
The analysis chamber is divided into three main parts: the stage, which positions the specimen; the local electrode, which applies a positive bias to the specimen; and the position-sensitive detector, which detects ions emitted by field evaporation. The chamber is maintained under an ultra-high vacuum of less than 10^{-10} torr to prevent the evaporated ions from colliding with residual gas molecules, which could generate noise. The specimen tip is kept at a temperature between 20–80 K to reduce thermal disturbances on the sample surface.

III. Function Description

A positive bias is applied to the needle-shaped specimen via the local electrode. When a laser pulse or voltage pulse is applied, surface atoms undergo field evaporation, pass through the local electrode, and hit the detector. The time delay between the pulse and the detection event provides the time-of-flight, which is used to determine the mass-to-charge ratio of the ion. The (X, Y) coordinates recorded by the detector are used to reconstruct the atom's (x, y) position on the specimen tip. The sequence of ion detection between pulses is used to estimate the atom's depth (z) during the reconstruction process.



IV. Types of Analysis

	Analysis Item	Description	Example
1.	Mass spectrum	APT can detect the mass-to-charge ratio (m/z) of ions in a material to generate a mass spectrum, enabling the identification of elements and isotopes.	
2.	3D atom distribution	Through reconstruction, the three-dimensional positions of atoms within the sample can be visualized. This enables the analysis of dopant distribution, layer thickness, and interface diffusion.	
3.	Concentration analysis	The atomic percentage (at%) of elements within a selected region can be calculated, and concentration profiles can be extracted along any direction. This is well-suited for studying doping gradients, diffusion behavior, and elemental segregation.	

1. Detectable elements: All elements
2. Detection limit: >100 ppm
3. Destructive measurement

V. Notes on Specimen Sampling

1. Sample quantity per commission form must not exceed 1 piece. Each sample must undergo FIB sample preparation, resulting in a tip radius between 50~100nm. (Attaching FIB images of the finished tip for reference is recommended.)
2. For multilayer samples, please describe the material structure, including the thickness of each film layer and its compositional elements. A TEM image should also be provided to verify the layer thickness
3. Contact information, Charge plan, and commission link

✓ Contact information:

Contact	Ext.	Email	Instrument Location
Ms. Yang	7615/7496	yuchyang@narlabs.org.tw	R221

✓ Charge plan:

No.	**Instrument**	**Charge Plan**		
		Self-operation (NTD/hr)	**Commission for operation (NTD/hr)**	**Note**
NM-022	Atom Probe Tomography (APT)	15,000	30,000	The academic charges a 10% fee.
Operation times under one hour will be billed as one hour.				

✓ Commission link: To request commission services, please go to the MES system to make a request.