

Appendix C05 - Sample Evaluation Instructions - Resolution and imaging

To evaluate whether the offered SEM and its required detectors are suitable for TNO research, a number of images is required of samples which will be provided to each potential supplier. TNO will provide the following 3 samples:

- **Sample 1:** Vertically aligned (VA-) CNTs on Si substrate
- **Sample 2:** 20 nm of 5nm AlOx/5 nm TiO₂ nanolaminate on Si substrate
- **Sample 3:** 15 nm Al₂O₃ on NMC cathode (on Al foil)

For each of the samples, images for the following categories are expected:

- **Sample 1: 3 images requested (no ion milling applied)**
 - Cat 1-1: Cross-section, overview of complete VA-CNTs (interface with substrate up to top of VA-CNTs)
 - Cat 1-2: Cross-section, high resolution, middle of CNT forest
 - Cat 1-3: Cross-section, high resolution, bottom of CNT forest, interface with substrate
- **Sample 2: 2 images requested (ion milled)**
 - Cat 2-1: Cross-section, overview image
 - Cat 2-2: Cross-section, high resolution image
- **Sample 3: 4 images requested (ion milled)**
 - Cat 3-1: Cross-section, overview image of complete NMC layer including interface with substrate.
 - Cat 3-2: Cross-section, top position high resolution image, aiming to measure the deposited layer.
 - Cat 3-3: Cross-section, middle position high resolution image, aiming to measure the deposited layer.
 - Cat 3-4: Cross-section, EDX map on overview/vertical-line-scan

Instructions for imaging.

Per sample category we expect images of the best attainable resolution with the standard detectors supplied with the SEM. For high resolution we expect images with a high lateral resolution, preferably up to 0.7 nm. TNO is aware that the attainable lateral resolution is sample dependent.

Images that are send in should be made with the detectors, that will be supplied as required. Per category and detector, the included image should include at least the following:.

1. At analytical (EDX) working distance using optimal beam and aperture settings for imaging.
2. Setting for highest resolution imaging of the sample(s), to be determined by the operator of the supplier.

Imaging shall be performed without the application of any additional sample preparation (e.g. C-, Au-sputtering, etc.).

The images are to be reported without any image enhancement.

The set conditions must be reported at least including:

- Working distance
- Beam current
- Acceleration voltage
- Applied deceleration voltage (if applicable)
- Type electrons used: SE, BSE, LA HA, Mixing,
- Probe current if available.
- Used detectors or combination of.
- Imaging using the supplied detectors on the SEM.
- Indication of the resolution by measurement of smallest visible (topographical) detail.
- Maximum field of view at lowest magnification.
- Milling time and milling conditions

Instructions how to provide the images

All images should be placed in the evaluation form, using the following instructions:

- Images are to be submitted in a word document with highest possible resolution.
- For imaging standard magnifications shall be used: 50.000, 100.000, 200.000, 500.000 and the maximum possible for all categories.
- Images fully anonymized (without logo) and only with Category number and a scale bar visible
- Per Category and magnification: max of 2 images focussed on the surface topography for different settings at one A4 page portrait view in BMP or TIFF format for review
- Separate BMP or TIFF format images in separate files (without compression)
- Settings per image (see instruction for imaging listed above) should be gathered per Category number in tables next to the corresponding images on the same A4 page of the document.

Evaluation of the images

The provided documents will be evaluated with a team of 4 people judging the quality of the images per category and magnification for each supplier. Per combination the images of all participants are placed on a screen and evaluated as follows:

- Ranking in groups based according to the sharpness, resolution (and contrast) as judged by each member of the team individually.
- The Groups of the best images get the maximum number of points assigned.
- The second best gets 50% of the maximum number of points assigned.
- The rest scores no points.
- In total 36 scans/A4 will be evaluated with a maximum score up to 200 points, according Table 1.
- The resulting score will be the average of all scores provided by the team members.

Table 1: Maximum scores per category & magnification

Category	x50k	x100k	x200k	x500k	x700k
Cat1-1	2	2	6	8	8
Cat1-2	2	2	6	8	8
Cat1-3	2	2	8	8	8
Cat2-1			6	8	8
Cat2-2	2	2	6	8	8
Cat3-1			6	8	
Cat3-2	2	2	6	8	8
Cat3-3			6	8	
Cat3-4	2	2	6	8	
					200