Technical Bulletin

sciTEM – Automated detection of different types of SEM and TEM support grids for high precision sample loading of nanomaterials

Introduction

TEM and SEM measurements are commonly applied as methods for characterization of nanomaterials. However, by nature of electron microscope instrument design placing sample supports under high vacuum, the number of samples that can be measured in a given time period is very limited. Having the capability to deposit multiple samples on one TEM/SEM support and then acquire all images without breaking vacuum for each one, results in a significant increase in the number of samples that can be analyzed per measurement cycle. A piezoelectric nanoliter dispensing technology, sciTEM, is applied for high precision non-contact printing of spots onto the supports.

SEM/TEM Support detection and sample loading

For high precision loading of nanoparticle dispersions on TEM and SEM supports image recognition software is utilized. This enables the detection of differently shaped support types and membrane structures. The use of two overhead CCD cameras with different fields of view, in combination with "Learn" and "Find" algorithms, ensures support grid placement and orientation recognition and therefore high precision sample deposition. Before sample loading of nanoparticles onto TEM support grids can be realized, the sciTEM software must learn the grids to be used. For correct teaching or learning, a "TEM Grid Wizard" guides the operator through the different steps. First, the support grids are placed in the spotting target area of the sciTEM. The global camera moves over the placed SEM/TEM supports and images them in real time. The support grid of interest can be marked by touching the touchscreen and the mark will be used for a more specific detection. A score then shows the match to the taught SEM/TEM support, Figure 1.

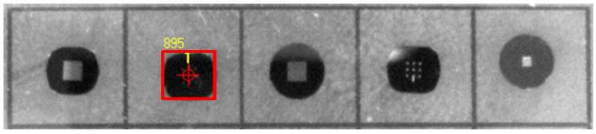

Figure 1. Global overview of different SEM/TEM support types and recognition of an individual support by using the "Find" algorithm.

A second CCD camera enables the fine recognition of the SEM/TEM support structures. Using the "TEM Grid Wizard" two individual fiducial markings of the support of interest need to be selected, Figure 2. The pattern will be saved and used for the recognition. Selection of specific dot pitches (drop center to drop center) and array size ensures precise sample loading onto the supports, Figure 3.

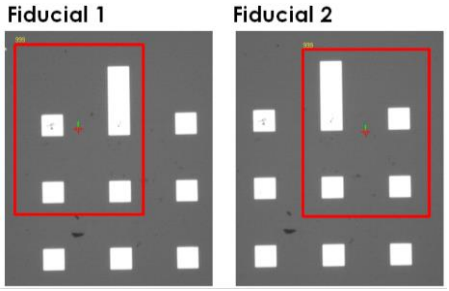

Figure 2. Camera recognition of specific grid patterns by different fiducial marks.

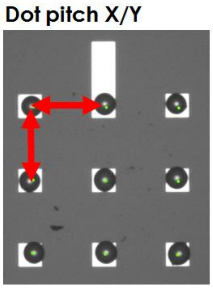

Figure 3. CCD image of a TEM support loaded with nine samples. Exactly defined pitches between the drop centers for high precision sample loading.

This technology and software can be adapted for diverse TEM and SEM supports with different geometries and substructures, Figure 4.

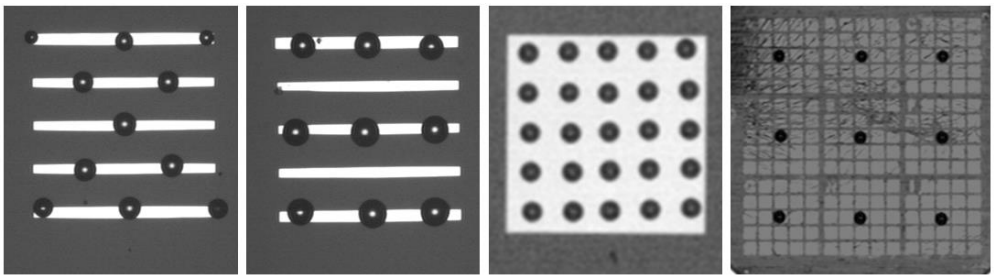

Figure 4. Examples of different types SEM/TEM supports after spotting before drying of printed droplets.

Summary

The sciTEM ensures the recognition of different types of SEM/TEM supports using a sophisticated camera and software system consisting of a "global" and a "head" CCD camera. This combination of hardware and software allows the high precision sample loading of SEM/TEM support grids.

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