



## Quanta 3D FEG

*This instrument is now available in EMSL's Radiochemistry Annex.*

The Quanta 3D FEG is the most versatile high-resolution, low vacuum SEM/FIB for 2D and 3D material characterization and analysis. Featuring three imaging modes - high vacuum, low vacuum and ESEM - it accommodates the widest range of samples of any SEM system. The Quanta 3D FEG's novel, field-emission electron source delivers clear and sharp electron imaging and increased electron beam current enhances EDS and EBSD analysis. This system also offers the capability for *in situ* study of the dynamic behavior of materials at different humidity levels (up to 100% RH) and temperatures (up to 1500 °C).

Quanta 3D FEG's unprecedented high-current FIB enables fast material removal. Automated FIB sectioning recipes enable accurate cross-sectioning. On top of the site-specific milling and excellent imaging capabilities of the FIB, platinum and carbon selection of gas chemistries is available to deposit materials or further enhance the FIB milling rate or material selectivity. Quanta 3D FEG features live SEM imaging while milling, making it a superior solution for fast preparation of large samples over a wide range of materials.



## Quick Specs

- ▶ Large-area cross-section, with the high ion beam current possible to do large areas
- ▶ Imaging non-conductive sample, with low vacuum and ESEM mode conductive coating not necessary
- ▶ 3D material characterization based on serial sectioning, using Slice and View and 3D EBSD software
- ▶ Milling non-conductive sample using charge neutralization mode using electron flood
- ▶ Radioactive samples acceptable in a non-dispersible mount. The ability to image and mill radioactive samples for TEM and atom probe analysis
- ▶ Oxford INCA software for both EDS and EBSD analysis, 80mm<sup>2</sup> SDD and fast acquisition EBSD camera
- ▶ OmniProbe for *in-situ* TEM and atom probe sample lift-out
- ▶ Low keV STEM detector available, CDEM detector for Channeling contrast using FIB-induced SE-Imaging
- ▶ Gas chemistry available, Platinum metal deposition and carbon deposition.

## Specifications for Quanta 3D FEG

### Electron beam resolution

- ▶ High vacuum
  - 0.8 nm at 30 kV (STEM)
  - 1.2 nm at 30 kV (SE)
  - 2.5 nm at 30 kV (BSE)
  - 2.9 nm at 1 kV (SE)
- ▶ Low vacuum
  - 1.5 nm at 30 kV (SE)
  - 2.5 nm at 30 kV (BSE)
  - 2.9 nm at 3 kV (SE)
- ▶ Extended low-vacuum mode (ESEM)
  - 1.5 nm at 30 kV (SE)
- ▶ Accelerating voltage: 200 V – 30 kV
- ▶ Probe current: up to 200 nA -continuously adjustable
- ▶ Magnification 30 x – 1280

### Ion optics

- ▶ High-current ion column with Ga liquid-metal ion source

- ▶ Acceleration voltage: 2 – 30 kV
- ▶ Probe current: 1 pA
- ▶ Ion beam resolution
- ▶ 7 nm at 30 kV at beam coincident point
- ▶ 5 nm achievable at optimal working distance

### Chamber vacuum

- ▶ High vacuum: < 6e-4 Pa
- ▶ Low vacuum: 10 to 130 Pa
- ▶ ESEM vacuum: 10 to 4000 Pa
- ▶ Beam gas path length: 10 or 2 mm
- ▶ Seamless transition between high and low vacuum
- ▶ Imaging gas in low vacuum and ESEM: water vapor or auxiliary gas

### Detectors

- ▶ Everhardt-Thornley SED
- ▶ Low-vacuum SED (used in low vacuum)
- ▶ Gaseous SED (GSED) (used in ESEM mode)
- ▶ IR-CCD

- ▶ Solid-State BSED
- ▶ Gaseous analytical BSED (GAD)
- ▶ (used for low-vacuum analytical applications)
- ▶ 14-segment Annular STEM
- ▶ CDEM

### 5-axis motorized stage

- ▶ Eucentric goniometer stage
- ▶ X = 50 mm
- ▶ Y = 50 mm
- ▶ Z = 25 mm
- ▶ Maximum sample height = 50 mm
- ▶ T = -15° to + 75°
- ▶ R = n x 360°
- ▶ Minimum step: 300 nm
- ▶ Repeatability @ 0° tilt; 2 μm
- ▶ Repeatability @ 52° tilt; 4 μm

To learn more about the Quanta 3D FEG and how it is being applied to EMSL users' research, see: <http://www.emsl.pnnl.gov/capabilities>

EMSL, a national scientific user facility, is available for free for open research. Learn how to become a user and about upcoming proposal calls at <http://www.emsl.pnnl.gov/access/calls/>.

## BRUCE AREY

Senior Research Scientist  
 bruce.arey@pnnl.gov  
 (509) 371-6485

