Journal of large-scale research facilities

Journal of large-scale research facilities, 2, A43 (2016) http://dx.doi.org/10.17815/jlsrf-2-68

Published: 04.02.2016

FEI Titan G2 80-200 CREWLEY

Ernst Ruska-Centre for Microscopy and Spectroscopy with Electrons (ER-C), Forschungszentrum Jülich and RWTH Aachen [*]

Instrument Officer:
- Dr. András Kovács, Ernst Ruska-Centre, Jülich Research Centre, 52425 Jülich, Germany, phone: ++49.2461.61.9276, e-mail: a.kovacs@fz-juelich.de

Deputy Instrument Officer:
- Dr. Roland Schierholz, Institute of Energy and Climate Research Fundamental Electrochemistry, Jülich Research Centre, 52425 Jülich, Germany, phone: ++49.2461.61.1686, e-mail: r.schierholz@fz-juelich.de

General Management:
- Dr. Karsten Tillmann, Ernst Ruska-Centre, Jülich Research Centre, 52425 Jülich, Germany, phone: ++49.2461.61.1438, e-mail: k.tillmann@fz-juelich.de

Abstract: The FEI Titan G2 80-200 CREWLEY is a fourth generation transmission electron microscope which has been specifically designed for the investigation of a wide range of solid state phenomena taking place on the atomic scale of both the structure and chemical composition. For these purposes, the FEI Titan G2 80-200 CREWLEY is equipped with a Schottky type high-brightness electron gun (FEI X-FEG), a Cs probe corrector (CEOS DCOR), an in-column Super-X energy dispersive X-ray spectroscopy (EDX) unit (ChemiSTEM technology), a post-column energy filter system (Gatan Enfinium ER 977) with dual electron energy-loss spectroscopy (EELS) option allowing a simultaneous read-out of EDX and EELS signals at a speed of 1000 spectra per second. For data recording the microscope is equipped with an angular dark-field (ADF) scanning TEM (STEM) detector (Fischione Model 3000), on-axis triple BF, DF1, DF2 detectors, on-axis BF/DF Gatan detectors as well as a 4 megapixel CCD system (Gatan UltraScan 1000 XP-P). Typical examples of use and technical specifications for the instrument are given below.

[*]**Cite article as:** Ernst Ruska-Centre for Microscopy and Spectroscopy with Electrons. (2016). FEI Titan G2 80-200 CREWLEY . *Journal of large-scale research facilities, 2*, A43. http://dx.doi.org/10.17815/jlsrf-2-68

1 System Overview

Figure 1: FEI Titan Titan G2 80-200 CREWLEY transmission electron microscope (photograph by courtesy of FEI company).

2 Typical Applications and Limitations of Use

The configuration of the FEI Titan G2 80-200 CREWLEY allows a variety of advanced transmission electron microscopy techniques to be applied to wide variety of solid state materials. These techniques include high-resolution scanning transmission electron microscopy (HRSTEM) with annular detectors for bright-field, annular dark-field, and high-angle annular dark field imaging, electron energy-loss spectroscopy (EELS), energy-dispersive X-ray spectroscopy (EDX), electron tomography (ET), and combinations of the previous techniques. The excellent analytical research possibilities make the instrument an ultimate solution for studies of the structure and chemistry of materials in high-spatial resolution.
The FEI Titan G2 80-200 CREWLEY is not intended for the investigation of aqueous, contaminated, ferromagnetic or organic samples without further discussions with both of the instruments officers and the ER-C general management.

3 Sample Environment

Apart from the special case of the utilisation of dedicated cooling or heating stages, the FEI Titan G2 80-200 CREWLEY will allow samples to be investigated either under room temperature or liquid nitrogen cooling conditions at a vacuum level of about 10^{-8} mbar. Besides this standard setup, the sample environment can be adapted to various conditions, e.g. the thermal treatment or the application of external electric or magnetic fields to samples, making use of a wide portfolio of in situ TEM holders available through the ER-C user services. The microscope is equipped with a large LN2 dewar, which holds liquid nitrogen for more than three days for optimum conditions around the sample.

4 Technical Specifications

- electron acceleration voltage 80 kV ... 200 kV
- X-FEG brightness @ 200 kV $1.8x10^9$ $A/cm^2/sr$
- symmetrical analytical S-TWIN objective lens $< \sim 5$ mm
- information limit (TEM) @ 200 kV 110 pm
- point resolution (TEM) @ 200 kV 240pm
- total system drift (TEM) < 300 pm min^{-1} (rms)
- resolution (STEM) @ 200 kV and 50 pA < 80 pm
- astigmatism instability (TEM) @ 200 kV < 0.6 nm/min
- combined electron probe and sample drift < 300 pm/min
- EDX system energy resolution (10 kcps) < 136 eV @ MnK_α
- EDX solid angle 0.9 sr
- EELS system energy resolution @200 kV 0.65 eV

5 Detectors

- Peltier cooled Gatan Ultrascan 1000 XP-P charge coupled device camera (CCD) with a format of 2048 x 2048 pixels of 15 microns in size.
- Gatan Enfinium 977 ER spectrometer with 2.5 and 5 mm entrance apertures, electrostatic shutter and advanced dual-EELS spectroscopy modes.
- Medium angle BF/DF Gatan STEM detectors.
- Fischione Model 3000 HAADF detector.
- FEI on axis triple DF1/DF2/BF detectors.

6 Specimen Stages

- double tilt low background holder ± 35 °
- high field of view single tilt tomography holder ± 70 °
- on axis rotation tomography holder 360 °
- further *in situ* specimen stages available

References

Du, H., Jia, C.-L., Mayer, J., Barthel, J., Lenser, C., & Dittmann, R. (2015). Atomic structure of antiphase nanodomains in Fe-doped SrTiO3 films. *Advanced Functional Materials*, *25*(40), 6369-6373. http://dx.doi.org/10.1002/adfm.201500852

Gan, L., Cui, C., Heggen, M., Dionigi, F., Rudi, S., & Strasser, P. (2014). Element-specific anisotropic growth of shaped platinum alloy nanocrystals. *Science*, *346*(6216), 1502-1506. http://dx.doi.org/10.1126/science.1261212