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FEI Tecnai G2 F20

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Abstract: The FEI Titan Tecnai G2 F20 is a versatile transmission electron microscope which is equipped with a Gatan Tridiem 863P post column image filter (GIF) and a high angle energy dispersive X-ray (EDX) detector. This set up allows for a variety of experiments such as conventional imaging and diffraction, recording of bright- and dark-field scanning transmission electron microscopy (STEM) images, or acquiring elemental maps extracted from energy electron loss spectra (EELS) or EDX signals.

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1 System Overview

Figure 1: FEI Tecnai G2 F20 transmission electron microscope
(photograph by courtesy of FEI Company)

2 Typical Applications and Limitations of Use

Since the FEI Tecnai G2 F20 is not equipped with any Cs corrector its resolution is limited to 2.4 Å in TEM mode (point to point resolution) and 1.9 Å in STEM mode. However, the large tilt angles of the specimen stage (see chapter 5 below) and the EELS and EDX capabilities make this instrument attractive for medium resolution work, e.g. for analyses of diffraction contrast and diffraction patterns or for determination of the chemical composition on the nanometer scale by electron energy loss spectroscopy, energy filtered transmission electron microscopy (EFTEM) or energy dispersive X-ray analyses.

3 Sample Environment

Samples are 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. In general, all types of materials can be investigated which do not harm the microscope and the specimen holders and which obey the ER-C's safety rules.

4 Technical Specifications

- electron acceleration voltage 120 kV ... 200 kV

- TEM – point to point resolution at 200 kV 2.4 Å
- TEM – information limit at 200 kV 1.4 Å
- TEM – objective lens Cs 1.2 mm
- TEM – objective lens Cc 1.2 mm
- TEM – magnification range 25 kx ... 1030 kx

- STEM – HAADF resolution 1.9 Å
- STEM – probe Cs 1.2 mm
- STEM – probe Cc 1.2 mm
- STEM – magnification range 150 x ... 230 Mx

5 Detectors

- Gatan UltraScan 1000P (2k x 2k) charge coupled digital camera equipped with a standard phosphor scintillator.
- Gatan Tridiem 863P post column image filter (GIF) with fully 2nd order and partially 3rd order corrected prisms yielding a total system energy resolution of 0.65 eV or better at a maximum field of view of 15 µm for imaging and 100 mR for diffraction analyses.
- High angle energy dispersive X-ray detector with a resolution of 136 eV or better for Mn K-alpha radiation. High angle energy dispersive X-ray detector with a resolution of 136 eV for Mn K-alpha radiation.
- Fischione Model 3000 HAADF detector.

6 Specimen Stages

- double tilt low background holder ± 40 °
- high field of view single tilt tomography holder ± 70 °
- dual-axis tomography holder ± 50 °

- on axis rotation tomography holder 360°
- further *in situ* specimen stages available

7 Instrument related Publications

Rieger, T., Luysberg, M., Schäpers, T., Grützmacher, D. and Lepsa, M. I. (2012). Molecular beam epitaxy growth of GaAs/InAs core-shell nanowires and fabrication of InAs nanotubes. *Nano letters*, *12*(11), 5559-5564. http://dx.doi.org/10.1021/nl302502b.

Imlau, R., Kovács, A., Mehmedovic, E., Xu,, P., Stewart, A. A., Leidinger, C. … Luysberg, M. (2014). Structural and electronic properties of β-FeSi2 nanoparticles: The role of stacking fault domains. *Physical Review B. 89*(5), 054104. http://dx.doi.org/10.1103/PhysRevB.89.054104.

Friedrich, M., Penner, S., Heggen, M. and Armbrüster, M. (2013). High CO2 Selectivity in Methanol Steam Reforming through ZnPd/ZnO Teamwork. *Angewandte Chemie 125*(16), 4389–4392. http://dx.doi.org/10.1002/ange.201209587.

Gan, L., Heggen, M., Cui, Ch. and Strasser, P. (2016). Thermal facet healing of concave octahedral Pt-Ni Nanoparticles imaged in-situ at the atomic scale: Implications for the rational synthesis of durable high performance ORR electrocatalysts. *ACS Catalysis 6*(2), 692–695. http://dx.doi.org/10.1021/acscatal.5b02620.