

Titan³™ G2 60-300

Ultimate performance and high tension flexibility in imaging and analysis in C_s -corrected S/TEM

The Titan³™ G2 60-300* is the most powerful high resolution scanning transmission electron microscope (S/TEM) with the largest acceleration voltage range of 60 to 300 kV for 2D and 3D material characterization and chemical analysis, down to the atomic level. The novel, environmentally isolated platform design allows for the ultimate performance in S/TEM imaging and chemical analysis by combining up to two C_s -correctors (probe and image C_s -correctors), a monochromator, and a novel, ultra-stable high brightness electron gun (X-FEG) in one instrument.

The option to combine two correctors enables studies in STEM mode with a focused probe and in TEM mode with a parallel beam with 70 pm resolution on the same specimen area in the same microscope. Hence the benefits of both imaging techniques can be obtained in a double-corrected S/TEM platform. With the acoustic and thermal environmental enclosure, the system can transfer information down to 70 pm and allows ultra-high resolution to be routinely achieved with ease and relaxed site specification for the installation.

The system is based on the Titan platform technology which is unmatched in mechanical, electronic, thermal, and optical stability and is designed to deliver the ultimate performance in all TEM, STEM, energy filtered TEM (EFTEM), diffraction and electron energy loss spectroscopy (EELS) & energy dispersive x-ray spectroscopy modes. The flexibility of operating the Titan³ G2 60-300 in the range of 60 to 300 kV allows the optimization of this important parameter to the requirements of the material examined, from ultra-light carbon compounds to ultra-dense heavy metal materials. Additionally, with the wide pole piece gap of the S-TWIN lens, the Titan³ G2 60-300 is designed for dynamic experiments, with space to do more around the sample area.

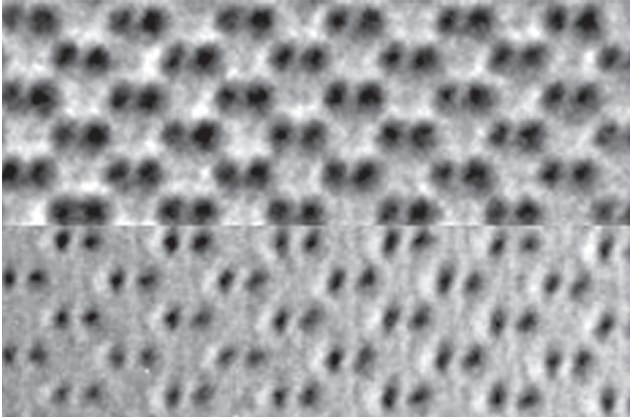
The new SmartCam remote user interface gives the freedom to operate the Titan³ G2 60-300 remotely, both for convenience, and to best maintain constant environmental conditions. The brilliant high speed digital camera and its innovative smart user interface make it not only easy but improve the handling of all applications. It flawlessly covers the complete high dynamic intensity range from live observation of focused high intensity beams to low dose applications and diffraction.

Key benefits

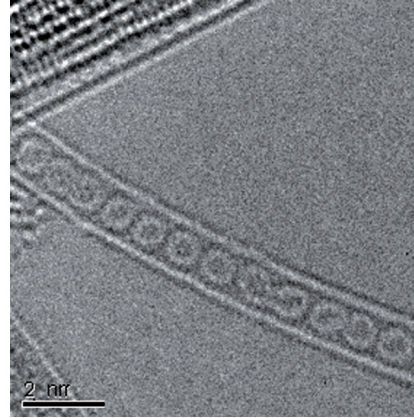
- Increase your imaging and analysis capabilities with the option of two C_s -correctors and a monochromator in one instrument
- Maximize the quality of the results by choosing the optimum acceleration voltage (60 to 300 kV) to minimize artifacts and maximize contrast
- Increase your lateral resolution to 70 pm while maintaining a large objective pole piece gap with 'space to do more' material science
- Maximize microscope time to do complex studies requiring ultra-high stability with the new cold trap design holding up to one week of nitrogen supply
- Minimize the influence of the environment on your experiments with the new revolutionary concept of an environmental enclosure
- Explore the freedom of full remote control functionality with the new high speed remote camera suite
- Maximize your coherence and brightness of the electron source with the unmatched performance of the X-FEG electron gun without a compromise in stability
- Decrease the installation requirements for acoustics and temperature variation

* pronounced Titan cubed

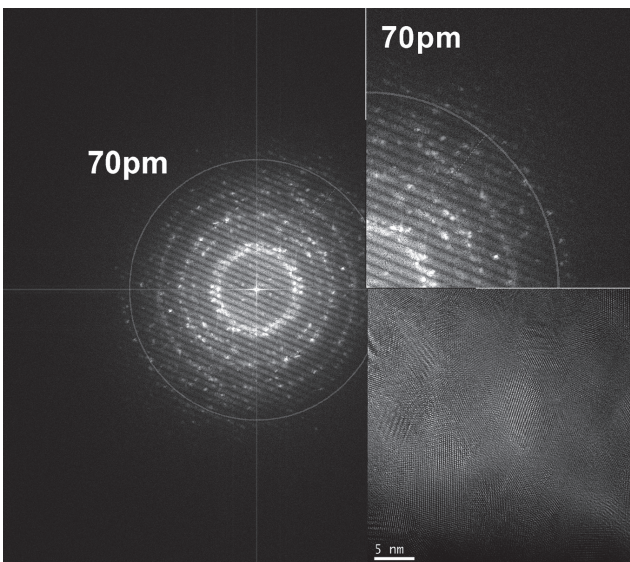
Application results on Titan³ G2 60-300



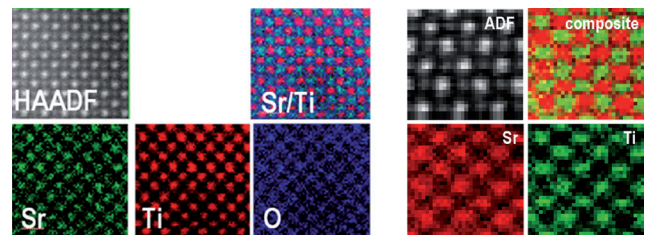
C_s-corrected HR-TEM image at 300 kV in Ge <110>. 0.7 eV energy resolution (upper image). 0.2 eV energy resolution (lower image).



C_s-corrected HR-TEM image on SWCNT filled with fullerenes acquired at 80 kV. Sample courtesy of Prof. N. Kiselev, Institute of Crystallography, Moscow, Russia.



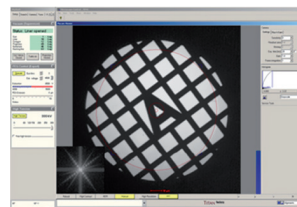
Young's fringe experiment on gold X-grating at 300 kV showing 70 pm information transfer at 300 kV.



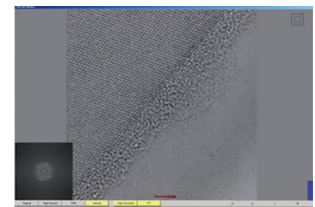
Atomic resolution EELS spectroscopy on SrTiO₃ acquired at 200 kV (left) and at 80 kV (right).

The sub-lattices of the crystal structure can be clearly resolved at both acceleration voltages.

Integration in normal UI

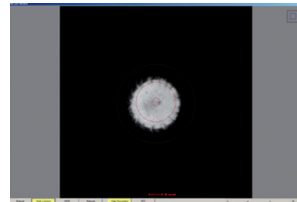


HR-TEM mode



Weak contrast of amorphous layers

HR-STEM mode

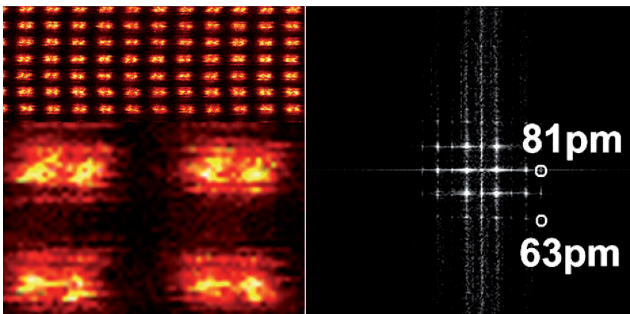


Ronchigram in HR-STEM

Diffraction mode



Kikuchi lines in diffraction



C_s-corrected HR-STEM image on Ge₁₂ at 300 kV with Fourier transformed showing 63 pm information transfer.

Easy to use SmartCam suite with automatic smart contrast adaptation in different modes from high dynamic range diffraction and low magnification applications to low contrast application like C_s-corrected HR-TEM and Ronchigram tuning in HR-STEM.

For detailed description see separate application note.

Titan ³ G2 60-300	Energy spread	Point resolution	Information limit	STEM resolution
Image corrector	0.7 to 0.8 eV**	80 µm	80 µm	136 µm
Probe corrector	0.7 to 0.8 eV**	200 µm	< 100 µm	70 µm
Monochromator / X-FEG Image + probe corrector	0.2 to 0.3 eV*	80 µm	70 µm	70 µm
Image + probe corrector	0.7 to 0.8 eV**	80 µm	80 µm	70 µm
* Depending on energy filter option ** S-FEG 0.7 eV, X-FEG 0.8 eV			Note: All specifications are at 300 kV For detailed list of specifications of other acceleration voltage, please contact your sales representative	

Technical highlights

- Optional ultra-stable, high brightness Schottky field emitter gun (X-FEG, for more details see separate product data sheet)
- New three lens condenser system with quantitative indication of convergence angle and size of illuminated area for quantitative measure of the electron dose and illumination conditions
- Flexible high tension from 60 to 300 kV (60, 80, 120, 200, 300 kV)
- On special request 60 kV C_s-corrector alignments available
- Double C_s-correction (probe and image C_s-correction) available
- Electron gun monochromator for high energy resolution in EELS and improved spatial resolution, especially at low kV HR-S/TEM
- 70 µm performance in both STEM and TEM
- Environmental enclosure to relax the acoustic and temperature room variation requirements
- Patented modular column design allows accurate mechanical stacking system for low excitation of the deflector units in the column to minimize instabilities due to electronic noise
- ConstantPower™ lens design for ultimate thermal stability in mode switches
- Low hysteresis design to minimize cross-talk between optical components for ultimate reproducibility
- Symmetric S-TWIN objective lens with wide pole piece gap design of 5.4 mm and 'space to do more' allowing the use of special holders such as heating, cooling and STM/AFM holders
- Objective aperture in the back focal plane of the objective lens for optimum TEM dark field application work
- Field upgradeable for the addition of a probe C_s-corrector
- Automatic apertures for remote control operation and reproducible recall of aperture positions during aperture change
- Rotation-free imaging for easy operation and clear orientation relationship between the image and diffraction plane
- Computerized 5-axes specimen stage for accurate recall of stored positions, tracking of the areas visited during search for the right area and ultra-stable, deep sub-Ångström resolution with low specimen drift

- Tilt range ± 40 degrees for analytical double tilt holder to orientate the maximum amount of zone axis of one crystal in polycrystalline material. With tomography holder even ± 80 degrees to minimize the missing wedge in 3D reconstructions
- New cold trap design for up to one week of operation to maximize up-time
- Field-free imaging in Lorentz mode with 2 nm resolution for magnetic property studies
- On special request C_s-corrected field free imaging in Lorentz mode with < 1 nm resolution for magnetic property studies
- Truelmage™ focus series software for quantitative HR-TEM applications (for more details see separate product data sheet)
- Xplore3D™ software for automated tomography S/TEM experiments and Xplore3D Xpress for ultra fast 3D reconstructions (for more details see separate product data sheet)
- New fully digital system for remote controlled operation using the SmartCam suite
- On special request the MultiLoader is available to minimize the initial drift after sample loading and maximize your throughput

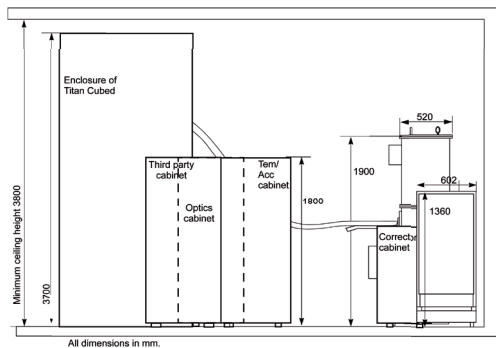
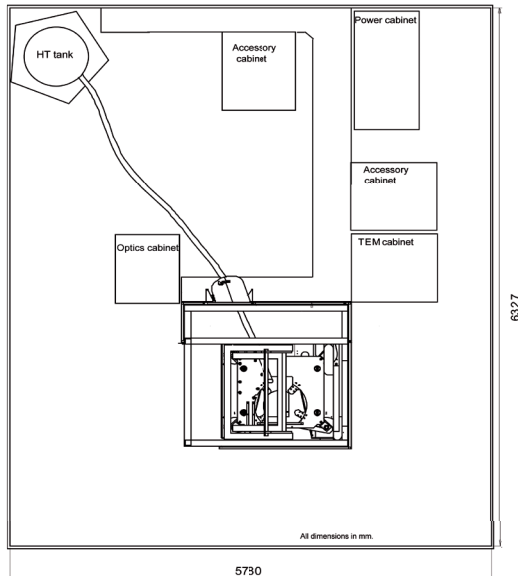
Detectors

- HAADF detector
- On-axis triple DF1/DF2/BF detectors (for more details see separate product data sheet)
- Gatan US1000/US4000 & Orius cameras
- Eagle series cameras
- Gatan energy filter series
- Plate camera
- Si(Li) EDS detector with solid angle of 0.13 sr and Fiori number > 4000

Holders

- Single tilt holder
- Double tilt holder
- Tomography holder
- Please ask for a further list of functional holders

Floor plan



Technical details on SmartCam suite

- High frame rate: up to 40 frames/sec for fast respond in search and alignment routines
- Automatic adaptable gain for high quality artifact free imaging
- Large magnification range from atomic resolution to low magnification applications
- Digital zoom for fast and easy change of magnification with a push button function
- Automatic high dynamic range mode for easy mode switches
- Smart user interface to adapt the dynamic range for different tasks: (bright) diffraction spots and (weak) Kikuchi lines can be observed in one image
- Ultra-robust scintillator design for even live observation of focused high intensity beams
- Live FFT for stigmation alignment and atomic resolution applications
- False color imaging for easier and more accurate orientation of the crystallographic zone axis
- All manual and automatic alignments can be executed with this search and view camera
- Primary control unit can be placed a distance of up to 15 m away from the column for remote control operation in a neighboring room

Installation requirements

- Environment temperature 18 to 23 °C
- Temperature stability 0.8 °C P-P, which is compatible with office air conditioning class ASHRAE 2001
- Heat dissipation into air nominal 4500 W
- Door height: 2310 mm (depends on version)
- Door width: 1000 mm
- Ceiling height: 3800 mm
- Floor space needed for microscope 5780 x 6327 mm
- Weight distribution max 1300 kg/m²
- Power voltage: 3 phase incl. neutral and earth 398 V (+ 6 %, - 10 %)
- Frequency 50 or 60 Hz (+/- 3 %)
- Power consumption with all microscope options max. 11.5 kVA
- Electrical connection single phase for water cooler 230 V, 4 kVA
- Cooling water required, depending on water cooling unit ordered
- Double earth connection required
- Compressed air supply, pressure min. 5 bar, max. 7 bar
- Nitrogen N₂, pressure min. 1 bar, max. 3 bar
- SF6 gas, proper ventilation required
- Pre-vacuum pump outlet
- Liquid nitrogen LN₂
- LAN connection for remote diagnostics



TUV Certification for design, manufacture, installation and support of focused ion- and electron-beam microscopes for the NanoElectronics, NanoBiology, NanoResearch and Industry markets.

Please contact your sales representative for more detailed information and for a complete pre-installation requirement document.

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