JEM-2100F

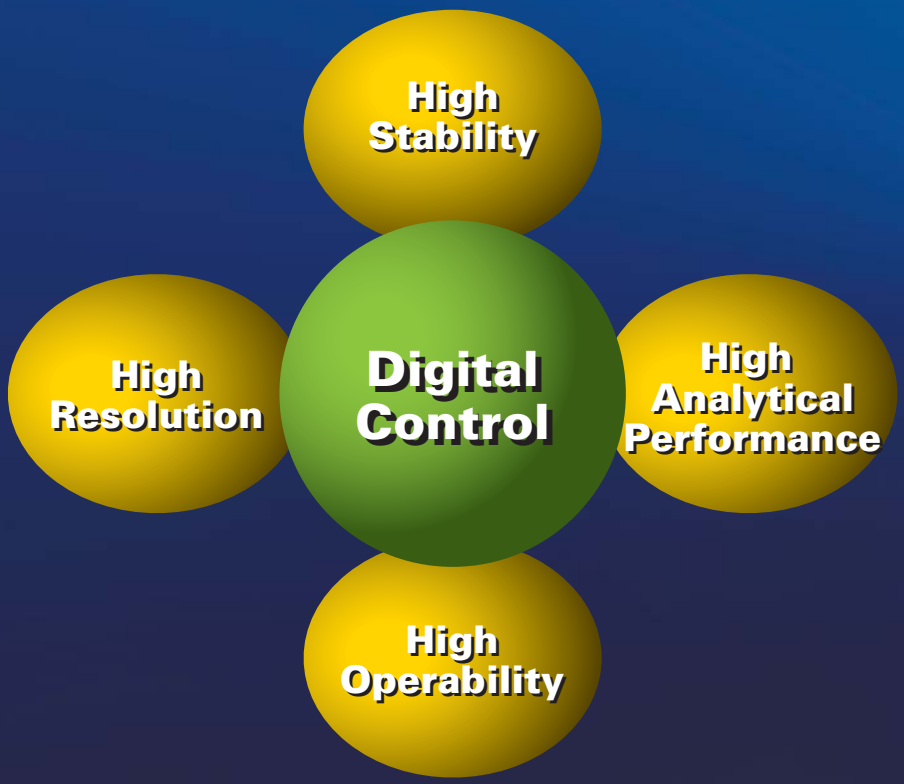
Field Emission Electron Microscope

JEOL

Serving Advanced Technology

For Nanoanalysis: Field Emi

Innovative scientific technologies used in today's nanotechnology and bioscience are making remarkable progress. In research on novel materials such as carbon nanotubes, semiconductors and ceramics, as well as basic research in medicine and biology, nanometer-scale inspection, evaluation and analysis are essential.
JEOL has developed a new, field emission transmission electron microscope (FE-TEM), the JEM-2100F, a modern instrument for the 21st century.
The JEM 2100F integrates a wealth of hardware and software and efficiently acquires valuable research information ... images, diffraction patterns, elemental measurements to name a few ... and enables you to directly view and study nano-scale structures.



Features

The JEM-2100F is equipped with a field emission electron gun (FEG) that produces high brightness (100 times greater than LaB_6 tip) and is highly stable. This feature is essential for nano-scale ultrahigh resolution and analysis.

The JEM-2100F incorporates multiple additional functions such as a high sensitivity scanning transmission electron microscope (STEM) image observation device and an energy dispersive X-ray spectrometer (EDS) system allowing simple and integrated data acquisition. All operations of the main instrument, including data display and instrument control, are integrated with a PC, thus greatly improving operability.
The EDS system uses a newly developed detector that provides sensitivity more than three times (compared to JEOL conventional detectors) for X-ray low energy regions.
This improvement allows faster analysis with higher reliability.

This combination results in optimum stage movement over the entire magnification range and can be used to stop drift during data acquisition. These benefits lead to efficient imaging and analysis.

ission Electron Microscope

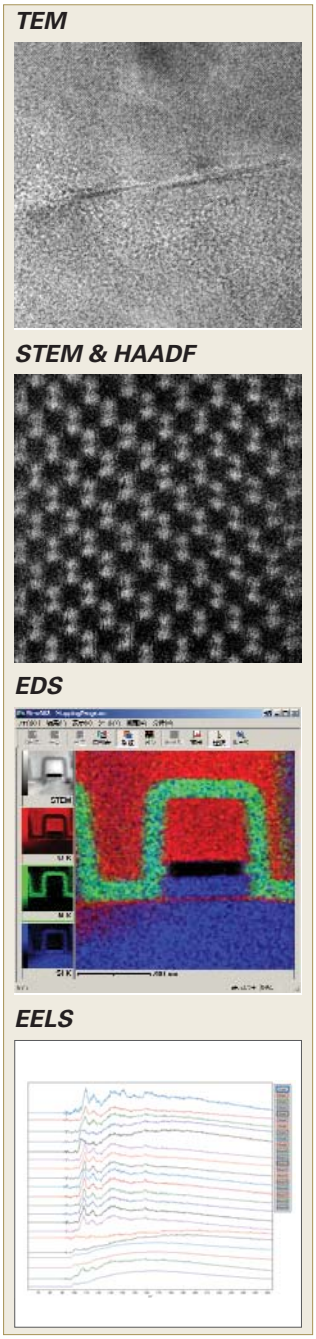
JEM-2100F

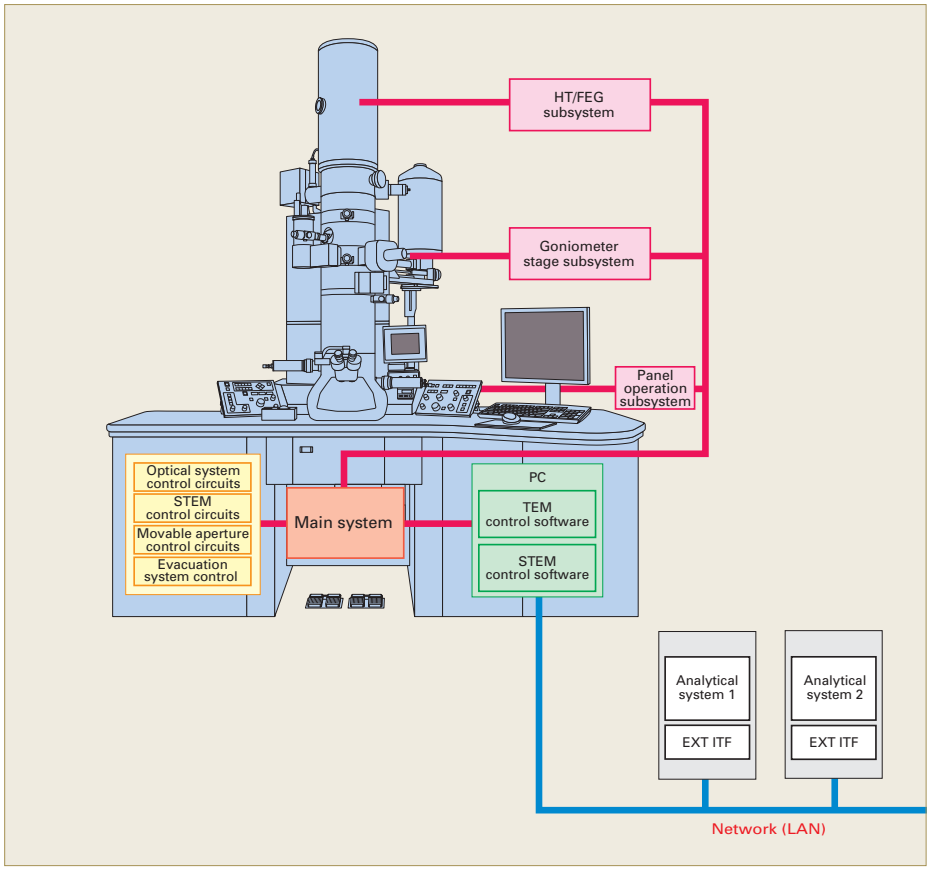
Integrated Operation Achieves Excellent Operability

Multi-functional control

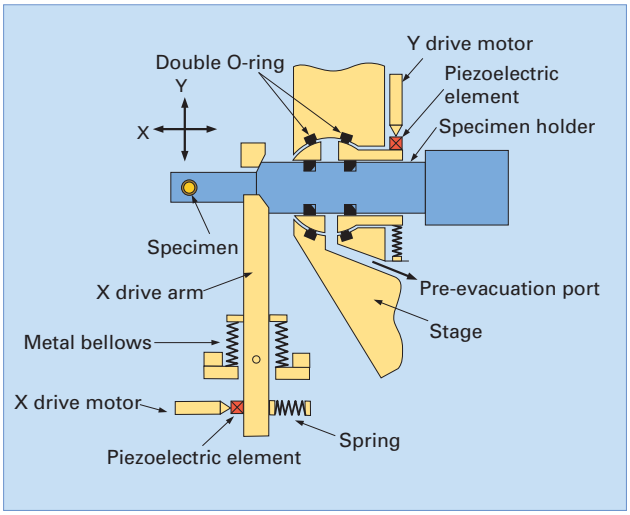
The control system of the JEM-2100F consists of the main system and a number of subsystems. The main system controls basic functions such as the electron optical system and evacuation system. The subsystem controls the electron gun, goniometer stage and panel operation. You can operate the two systems through a host PC built in the instrument designed to comprehensively manage data.
Also, the control system can easily add new functions to the instrument, for example an EDS system and a newly developed scanning image observation device. Furthermore, using the networking capabilities of a PC, you can easily connect various analytical attachments and imaging devices to the instrument.
The control technology of the JEM-2100F integrates a wide range of systems, and is the keystone for adding expanding new TEM application fields.

Analytical capabilities



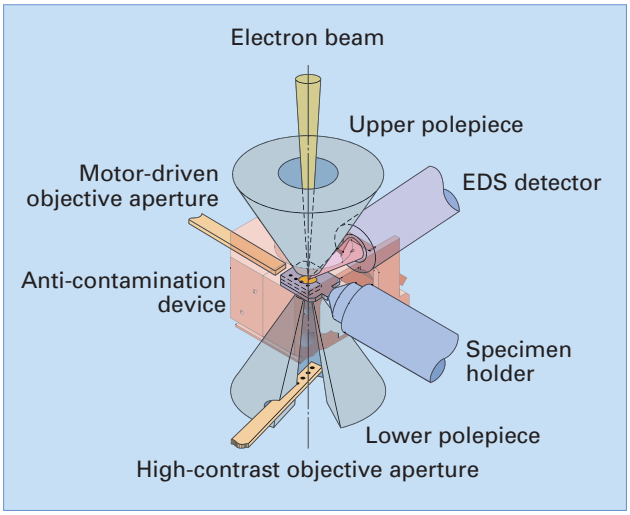


Nano Control Mechanism



New goniometer stage

The newly developed goniometer stage achieves precise specimen movement and stable specimen holding. In particular, the specimen moves with the highest accuracy over a wide range of magnifications: from low magnification to the maximum magnification for nano-area imaging.
This new stage comes with a control mechanism that uses a piezoelectric element, allowing fine specimen movement in nanometer areas.
The stage also incorporates a touch-sensor safety mechanism (JEOL patent), allowing maximum tilt over the eucentric range X,Y and Z movement.

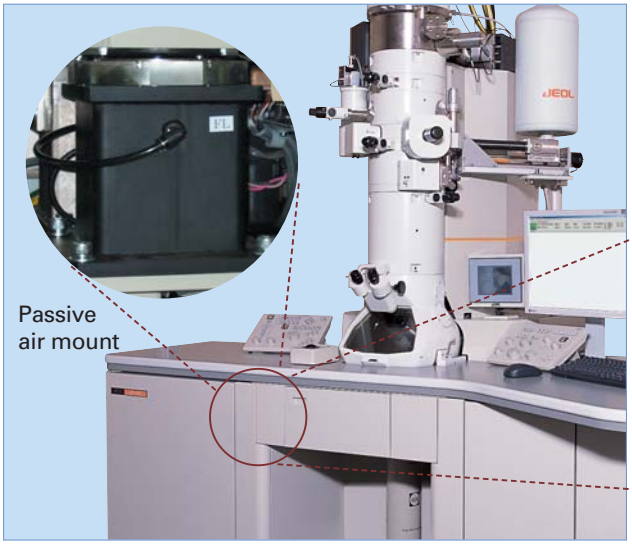


Large solid angle EDS *(option)*

To achieve high energy resolution and high sensitivity, the new EDS detector is designed for large solid angle and take-off angle, both of which are essential parameters for X-ray acquisition.

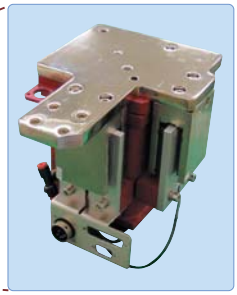
JED-2300T

Solid angle:	0.28sr
Take-off angle:	24.1°
Detector:	50mm^2
	At high resolution configuration



Vibration-proof instrument structure

Measures to prevent vibration are important factors.
The JEM-2100F uses a new base frame and a passive air mount greatly reducing vibration sensitivity.



Active air mount *(option)*

The active air mount, having excellent anti-vibration performance, detects floor vibrations and drives an actuator in the opposite direction of the vibrations.

STEM Expands Analysis Applications

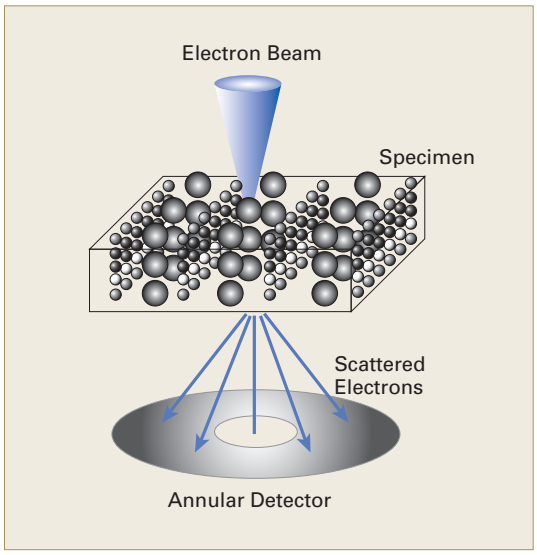
High resolution STEM images
(option)

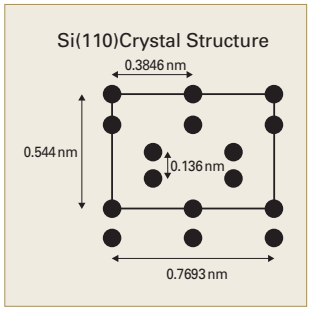
Control of the scanning image observation device is integrated into the main instrument computer. By the employment of a full digital system, you can easily obtain a variety of high resolution STEM images. The images are displayed on the monitor of the main instrument.

HAADF (option)*

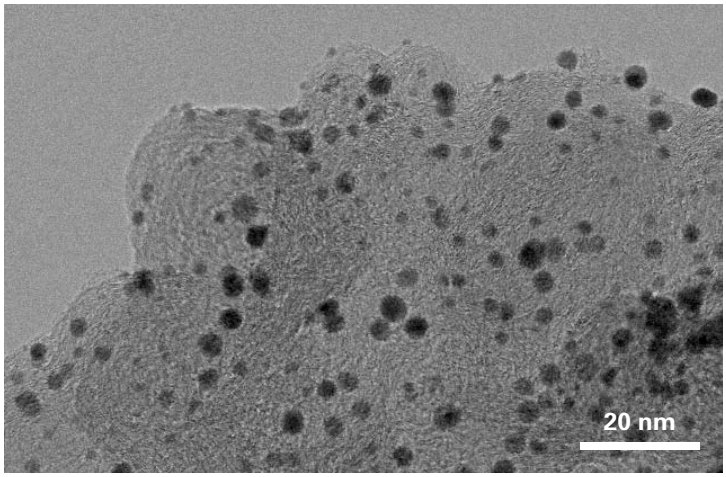
The dark-field detector used for imaging is annular in shape. This imaging method reduces the effect of the thickness of the specimen and eliminates diffraction contrast. High-angle incoherent scattered electrons produce images whose contrast depends on Z (atomic number).

*High-Angle Annular Dark-Field.



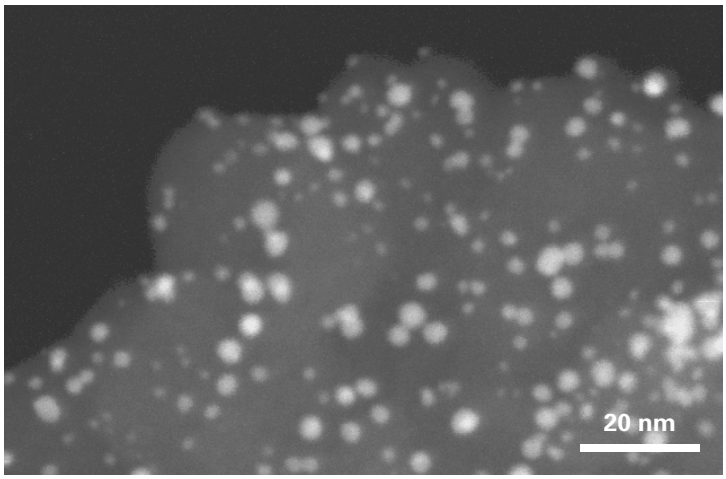


STEM bright filed image (BFI)



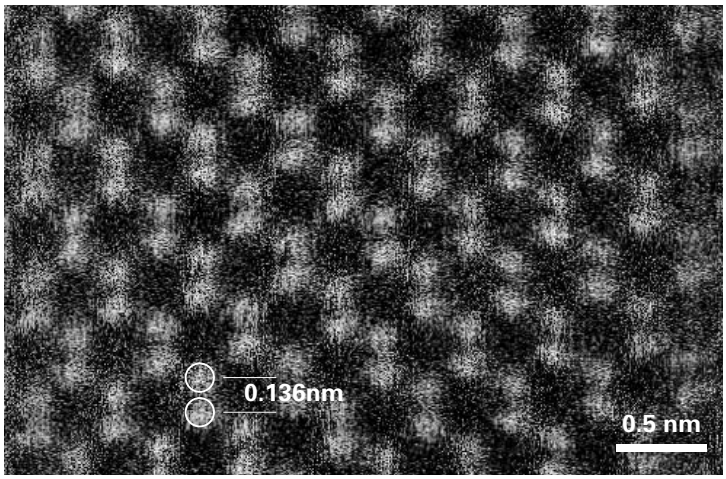
Specimen: catalyst

HAADF



Specimen: catalyst

HAADF

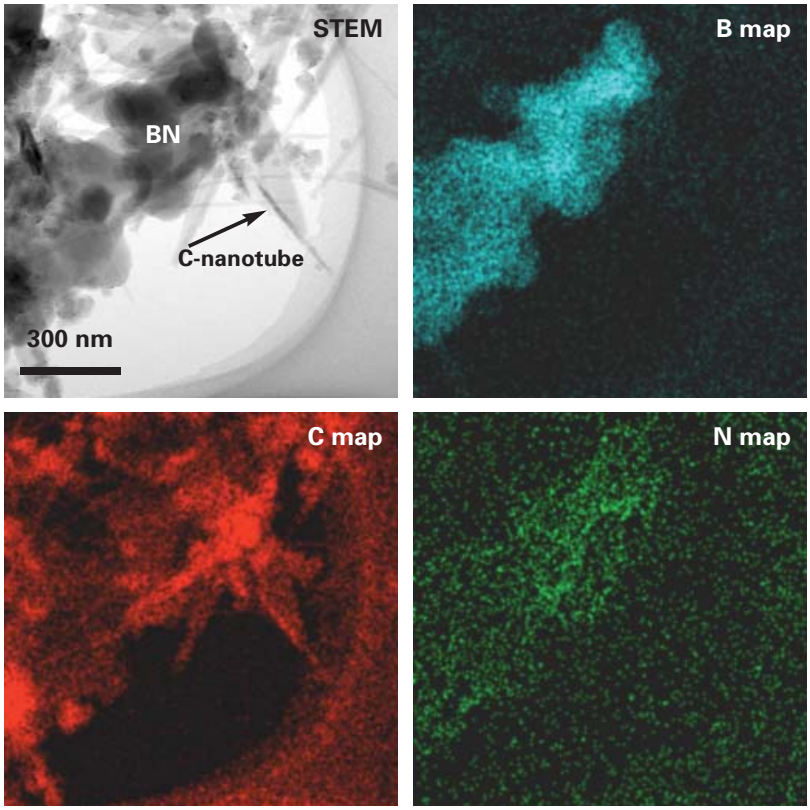


Dumbbell image Specimen: Si (110)

High Sensitivity High Resolution EDS Analysis

EDS system (option)

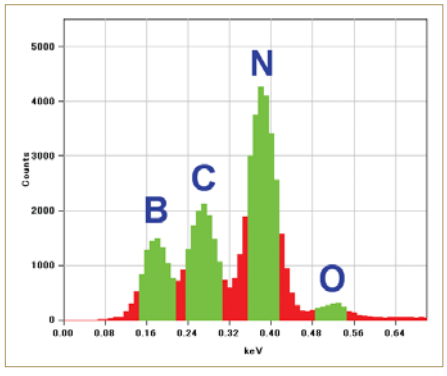
The JED-2300T energy dispersive X-ray spectrometer is a data management system fully integrated into a TEM.
You can obtain the microscope parameters such as magnification and accelerating voltage from the TEM during acquisition.
You can also preset acquisition conditions for elemental mapping and multi-point analysis using STEM image on the screen. In addition, Analysis Station automates acquisition, storage, and management of data.
Together with the STEM drift correction system, Analysis Station enables you to perform high-precision elemental mapping and multi-point analysis because this system allows long-time acquisition with high sensitivity and high energy resolution.



Specimen: carbon nanotube on boron nitride
Courtesy of Dr. Yoshio Bando
Advanced Materials Laboratory, National Institute for Materials Science.

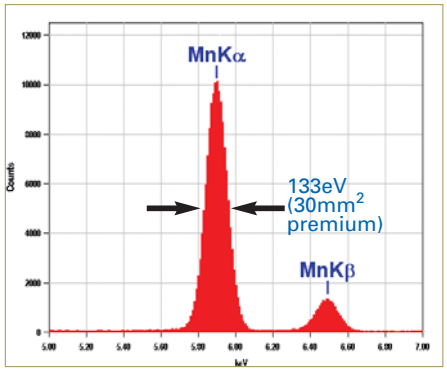
Better resolution at low energies

JEOL's unique ultra-thin window detector makes it possible for the JED-2300T to detect light elements. Also, since the JED-2300T offers high energy resolution in low-energy regions, it clearly separates peaks of light elements such as boron (B), carbon (C), nitrogen (N) and oxygen (O). Optionally, the JED-2300T can be equipped with a new detector for high-sensitivity analysis, having a wide effective detection area of 50 mm^2 and an acceptance solid angle of 0.28 sr.



High energy resolution

The JED-2300T uses a newly developed digital pulse processor and an improved detector. These features allow efficient acquisition of high energy resolution X-ray spectra and high-speed analysis.



Drift-free Mapping, Spectrum Imaging

Drift correction system (option)

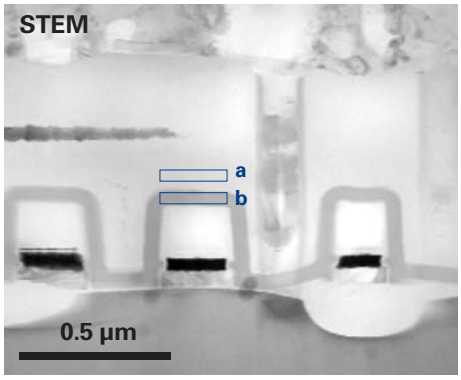
The STEM drift correction system allows long-time, stable acquisition, making it possible to acquire elemental maps with high spatial resolution and high S/N ratio. In addition, this system provides high energy resolution and high sensitivity to light elements, enabling you to obtain accurate distribution of light elements such as oxygen (O) and nitrogen (N). These features enhance the precision and efficiency of materials evaluation.

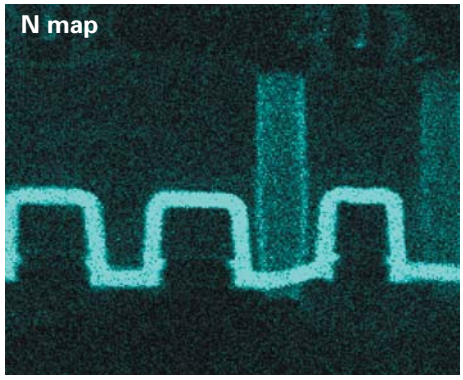
- Specimen: DRAM
- Acquisition time: 60 minutes

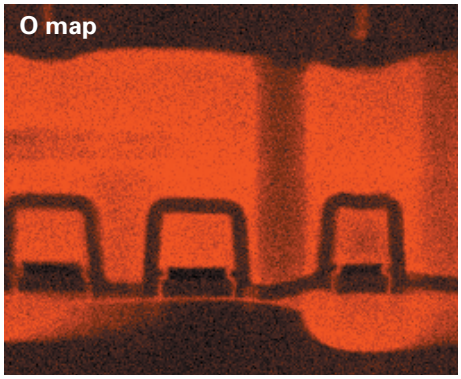
EDS active mapping function

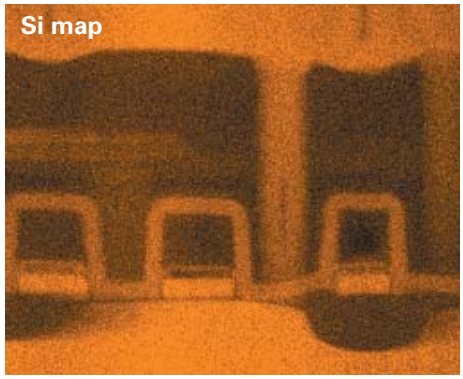
(spectrum imaging: option)

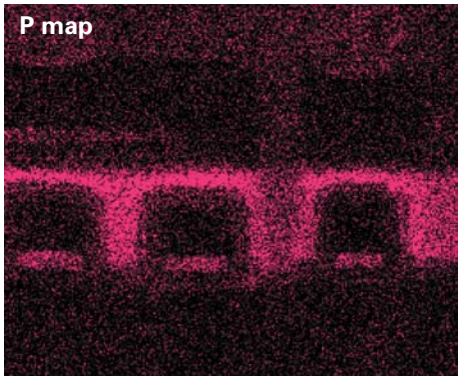
All pixels in the X-ray mapping data contain spectral information.
After acquiring the mapping data, you can select and add elements to display, set the ROI again, and extract spectra from the desired position (point and area).

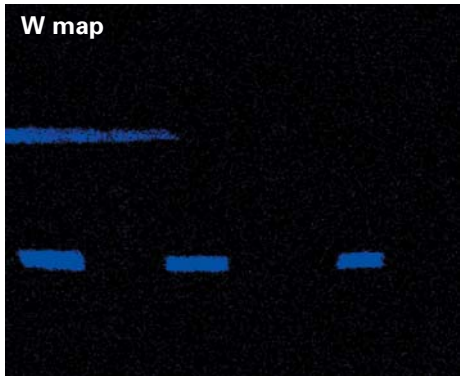


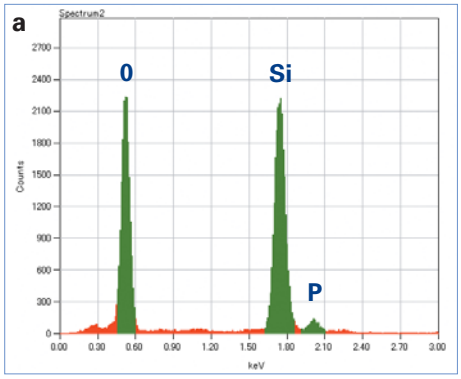




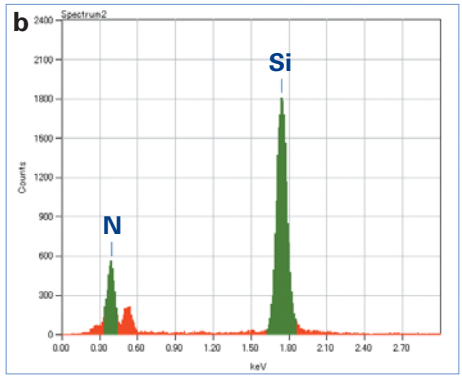








Spectra extracted from Area □ a in the STEM BEI.

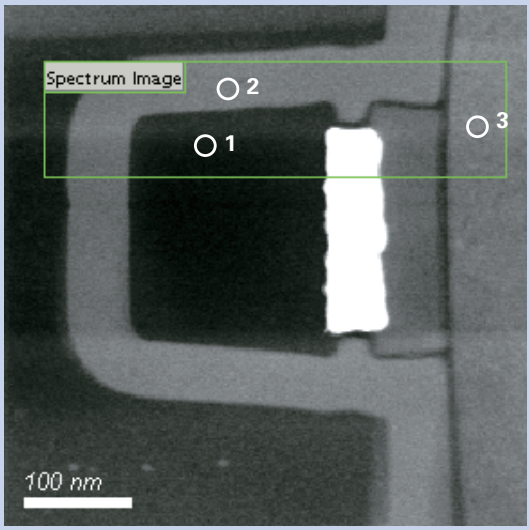


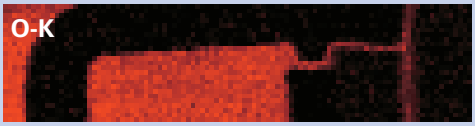
Spectra extracted from Area □b in the STEM BEI.

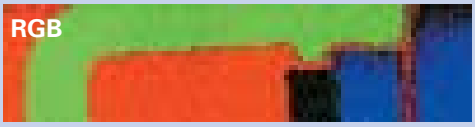
Nano-Area Structure Analysis (EELS Analysis)

Optional EELS maps also allow high sensitivity, high spatial resolution analysis by the use of a high stability, high brightness FEG.

HAADF images and EELS spectra

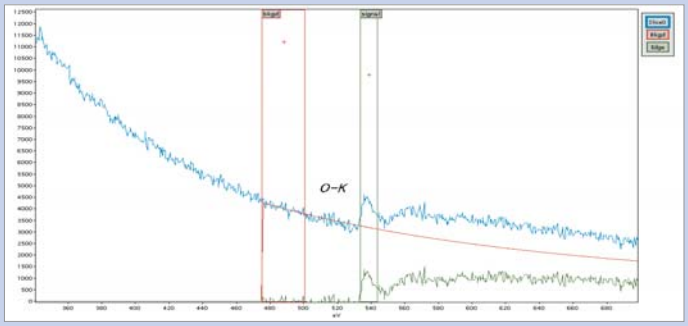




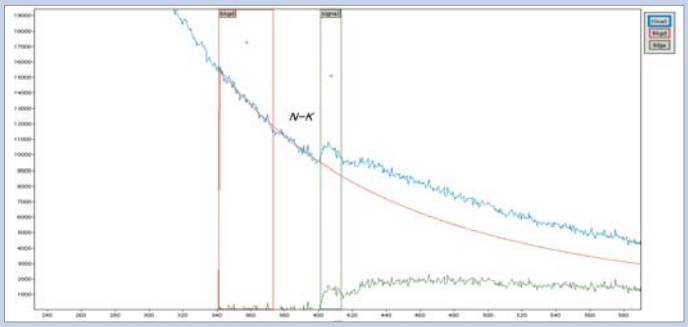


Specimen: 64MB DRAM

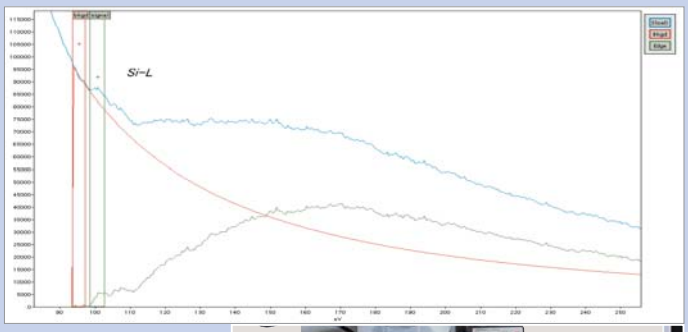
Spectrum from Point 1



Spectrum from Point 2



Spectrum from Point 3



GATAN EELS spectrometer is installed.

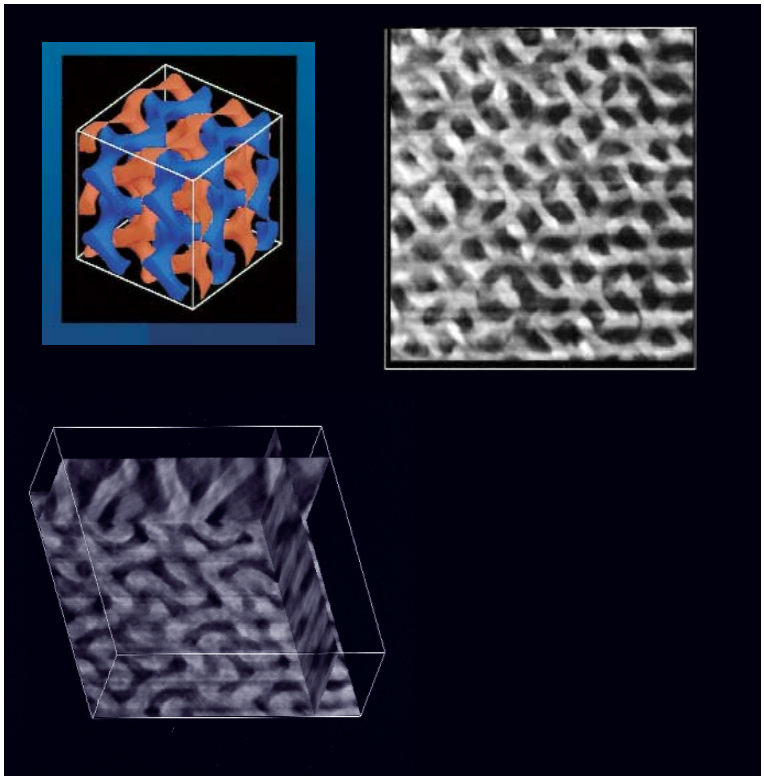
Automatic 3D Structure Analysis

TEM 3D tomograph (option)

3D structure analysis macromolecule materials and biological specimens enables one to obtain unique information.
In the TEM observation mode, the specimen is tilted from +60° to –60° in fine steps and the recorded images are PC-processed and are subjected to 3D reconstruction for analysis.

Specimen: Gyroid
Thin section (150 mm to 200 mm)
Tilt angle: –60 to +60° (2.5° steps)
Accelerating voltage: 200 kV

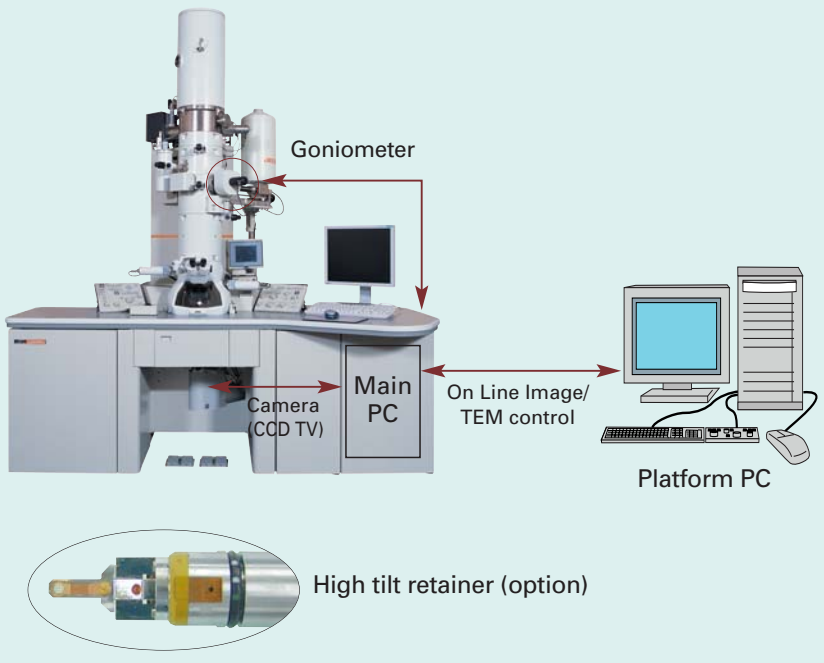
Specimen courtesy of Dr. H. Hasegawa of Kyoto University and Dr. K. Jinnai of Kyoto Institute of Technology



3D reconstruction system (option)

The specimen is tilted and the images acquired at each step are accumulated. The resulting images are then processed in order to reconstruct a 3D image. This process can be automated on line by linking the high-end algorithm developed by JEOL with a high-precision goniometer.

TEM and 3D Configuration

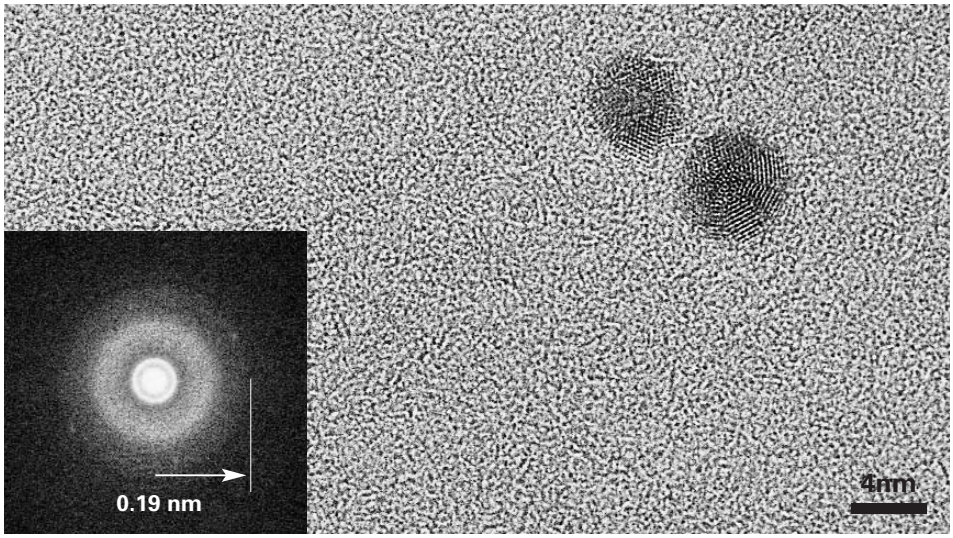


High Resolution Supported by High Stability Instrument

Ultrahigh resolution data showing overall performance

Specimen:
Amorphous Au particles on Ge film
Direct magnification:
×250,000
Enlarged magnification:
×250,000
Point resolution:
0.19 nm

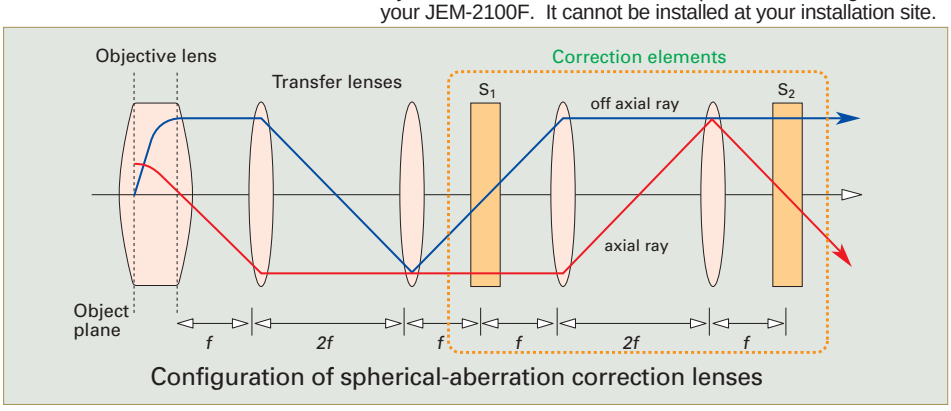
Ultrahigh resolution configuration



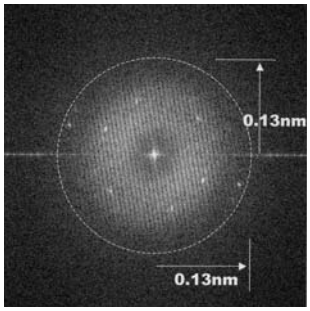
Make the spherical aberration coefficient (Cs) = zero: much higher resolution!

You can obtain ultimate high resolution by installing the optional Cs corrector into the JEM-2100F.

*If you want to use this Cs corrector, please order it together with your JEM-2100F. It cannot be installed at your installation site.



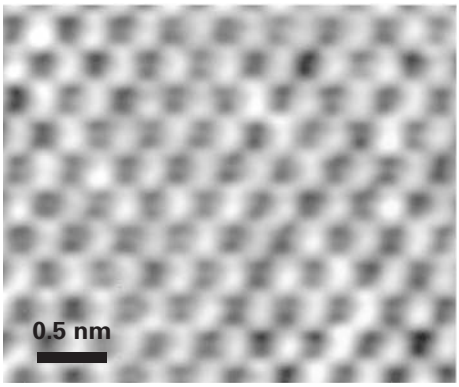
Configuration of spherical-aberration correction lenses



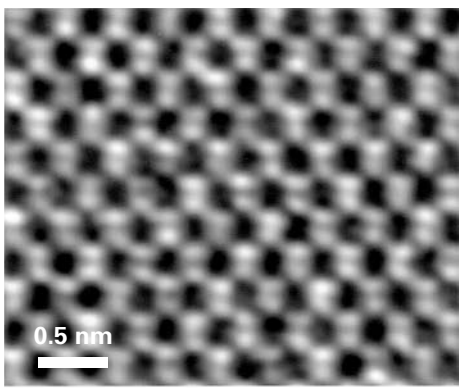
Cs: 0.003 mm
Point resolution: 0.13nm

The radius of the circle corresponds to 0.13 nm resolution.

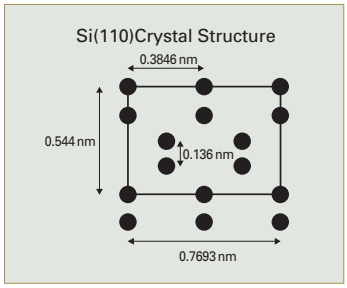
High resolution image of Si [110]



(Cs=0.03mm) ΔF=–10nm



(Cs=–0.03mm) ΔF=10nm

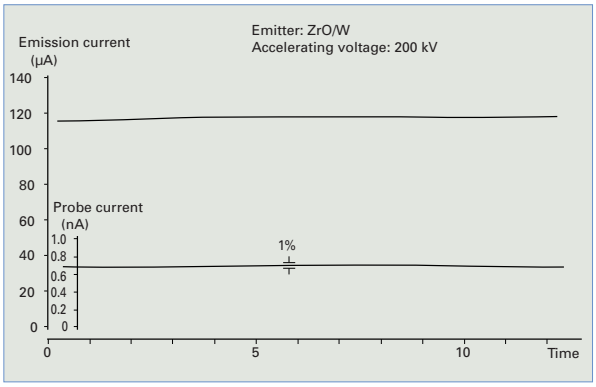


Since Cs can be set to minus value, a structure image can be easily obtained even when the specimen is thick and the effects of nonlinear terms cannot be neglected.

Highly Stable HT System and Electron Optical System

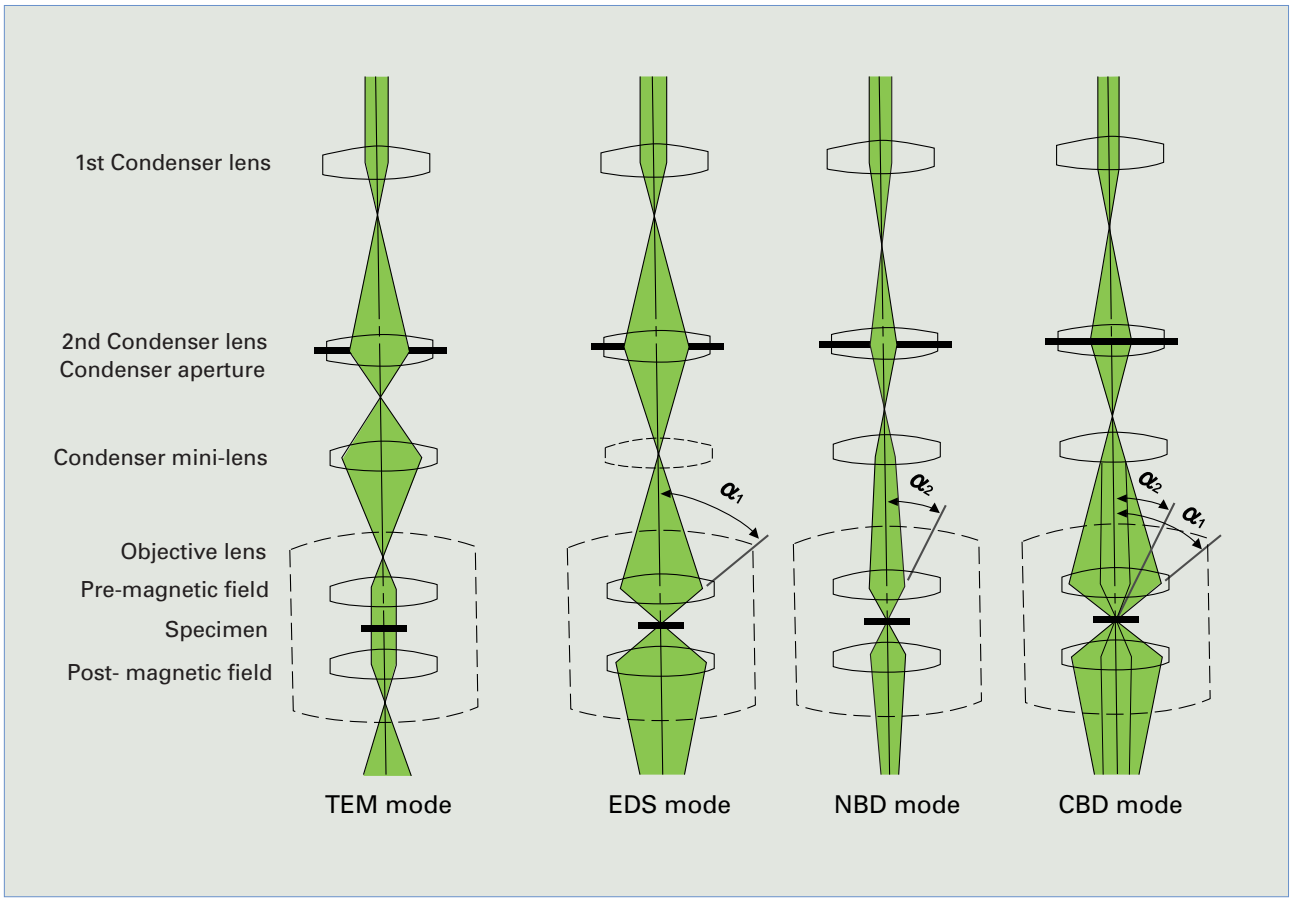
Highly stable emission current

Highly stable emission of an electron beam, as well as high stability of the high voltage (HT) system, is very crucial to analytical TEM.
Stability of the probe current is essential to achieve reproducibility results during analysis. The figure confirms the stability of the FEG of the JEM-2100F.



Quick Beam Select System

The Quick Beam Select System is provided for the following four illumination conditions: TEM image observation, EDS analysis, nano-beam diffraction (NBD) and convergent-beam diffraction (CBD). You can select the optimum condition from these four modes with one touch operation. This system enables you to easily perform high precision, microarea analysis, parallel illumination for imaging and CBD.



Optional Attachments

Scanning image observation device Full digital control

The BFI and DFI-HAADF detectors for STEM images and the image acquisition unit are provided.

- Scanning image observation device (ASID) EM-24540
- Image acquisition unit EM-27100
- Dark field image observation device EM-24560

Dry pump system

- TMP rough pump unit EM-23085
- TMP vacuum pump unit EM-23075

Imaging 3-fold astigmatism correction unit

The components of three-fold astigmatism may have a negative effect on analyzing crystal boundary structures in a high-resolution image or in determining crystal symmetries.
This unit corrects these undesired components and eliminates the effects of three-fold astigmatism.

Motor drive aperture Remote control

- Motor drive CL aperture EM-20330
- Motor drive OL aperture EM-07320
- Motor drive OL high contrast aperture EM-20340
- Motor drive IL aperture EM-20350
- Motor drive hard X-ray aperture EM-20360
- High tilt retainer EM-21310

Extensive specimen holders

With the employment of the 5-axis motor-driven microactive goniometer, the tip of the specimen holder is not subject to compressive stress due to atmospheric pressure, thus making it possible for the JEM-2100F to use an ultra-thin specimen holder. The quick specimen retainer, provided as standard, enables you to quickly exchange the specimen only by switching the tip of the holder. Also, extensive specimen holders are available, including the specimen tilting holder, the beryllium specimen tilting holder, the specimen heating holder, and the specimen cooling holder.

Energy dispersive X-ray spectrometer JED-2300T

Unique selection of detectors with up to 0.28 sr solid angle Excellent resolution at low energies. High speed analysis for sensitive specimen characterization Drift free mapping for light element mapping with high spatial resolution.

EU's product safety standard

ISO 9001:2000 & 14001:1996 REGISTERED FIRM
DNV Certification B.V., THE NETHERLANDS
ISO 9001 Certificated
ISO 14001 Certificated

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