Hitachi High-Technologies

Transmission Electron Microscope

H-7650

HITACHI

The H-7650 is Hitachi's latest transmission electron microscope developed specifically for applications in research fields such as biology, medicine, polymers and other advanced materials. Allowing high contrast low dose image observation, the H-7650 is optimized to reduce specimen damage associated with typical electron microscopy observation.

A high sensitivity digital camera has been integrated with the microscope and images can be recorded, stored, filed, or transferred to anyone in the world efficiently and effortlessly.

Features:

1. A high sensitivity*1 and 1,024 × 1,024 pixel digital camera integration
- *Integrated digital camera*
- *Windows XP*2 GUI*

2. Automated functions
- *Auto focus/auto stigmation*
- *Digital auto photo mode*

3. Rapid and simplified stage recall
- *The auto drive function utilizes parameters stored with each acquired image to recall saved locations.*

4. Low magnification/wide field of view/high contrast image observation
- *Low magnification: An image of 200× is available in normal Zoom mode*
- *Wide field of view: A 320 μm^2 field of view at the specimen using a digital auto multiple frames mode (Objective aperture of 10μm for a direct 200× image in Zoom mode)*

5. High magnification imaging
- *Image observable on monitor screen at magnifications as high as 9,500,000×*3*

6. Image archiving software
- *Thumbnail display of images*
- *Database image search/image processing function*

7. Convenient and useful functions
- *Digital auto multiple frames*
- *Digital low dose*
- *Automated particle search (option)*
- *Automatic tilt image acquisition system (option)*
- *TEM X-ray mapping (option)*

Notes:
**1 Approximately 40 times higher sensitivity than conventional silver halide film.*
**2 Windows is a registered trademark of Microsoft Corp., U.S.A.*
**3 19" LCD monitor and magnifications are subject to change with available monitors.*

Transmission Electron Microscope

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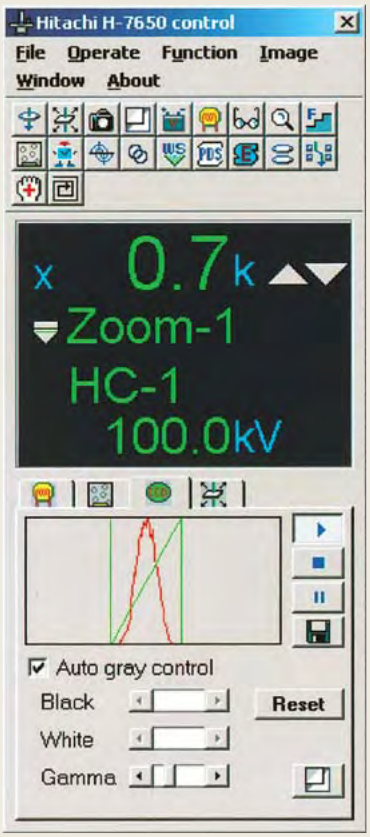
Integrated digital camera for ultimate user-friendliness

- *Windows XP* GUI allows display of the operating conditions of the microscope with the corresponding microscope image. This also permits control of various functions of the microscope using straight forward icons.*
- *Digital camera control is possible on the same monitor screen. This design allows operators to optimize camera conditions while watching the digital camera image and microscope parameters.*
- *Digital camera image observation in real time. Allowing operators to search the field of view for their area of interest directly on the monitor screen.*
- *The system stores digital camera images with the operating conditions of the microscope, including specimen position, allowing these parameters to be recalled from the database.*



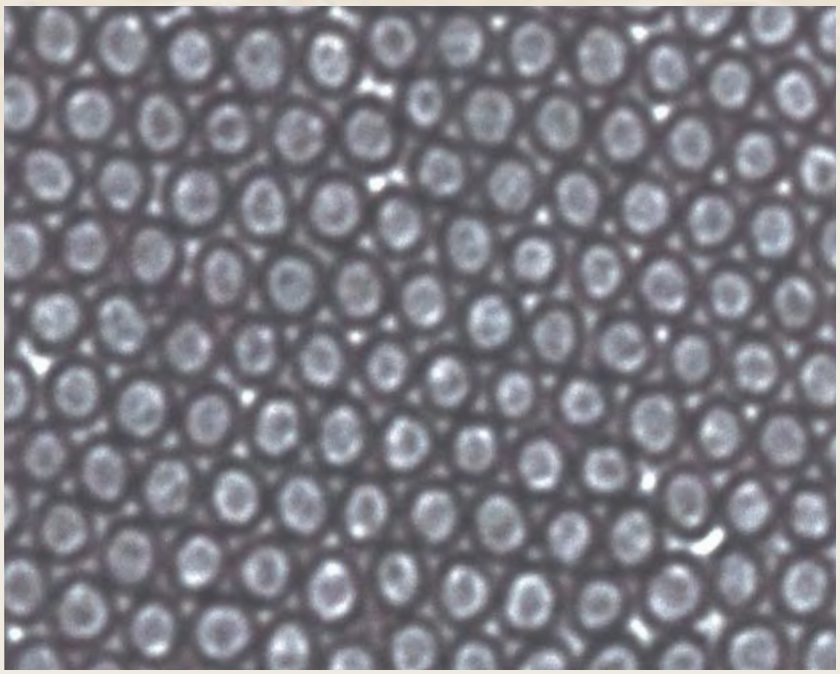
GUI image for digital camera control

A typical microscope image of rat kidney

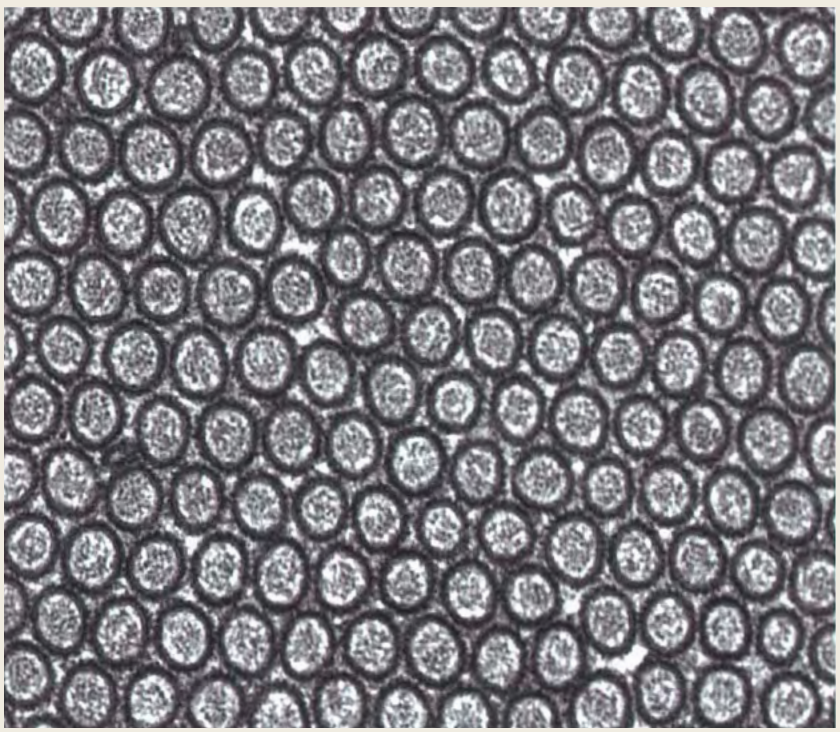
Quality images are available with simple automated operation

- *Auto focus/auto stigmation*
  Manually a time consuming operation, image focusing and astigmatism correction is automated. Precise and quick operation is available effortlessly and quality microscope images are available in a digital format. All levels of users can quickly adapt to produce high quality images using the H-7650 automated functions.
- *Digital auto photo mode allows fast storage of crisp digital images with one click of the mouse.*

Unfocused condition



After execution of auto focus



Specimen: Small intestine of rat (fixed with glutaraldehyde, osmium tetroxide and tannic acid), courtesy of Associated Professor Hiroyuki Sasaki, Institute of DNA Medicine, The Jikei University School of Medicine
Direct magnification: 10,000×
Accelerating voltage: 100kV

Auto drive mode allows display of specific fields of interest quickly

- *Auto drive mode*
  All microscope images recorded using a digital CCD camera are displayed in a thumbnail format. Each thumbnail image has the corresponding properties or operating conditions of the microscope. When the operator clicks any one of thumbnail images and selects the auto-drive mode, the system drives the specimen stage to the corresponding position automatically for showing the specimen image at any magnifications specified by the operator.

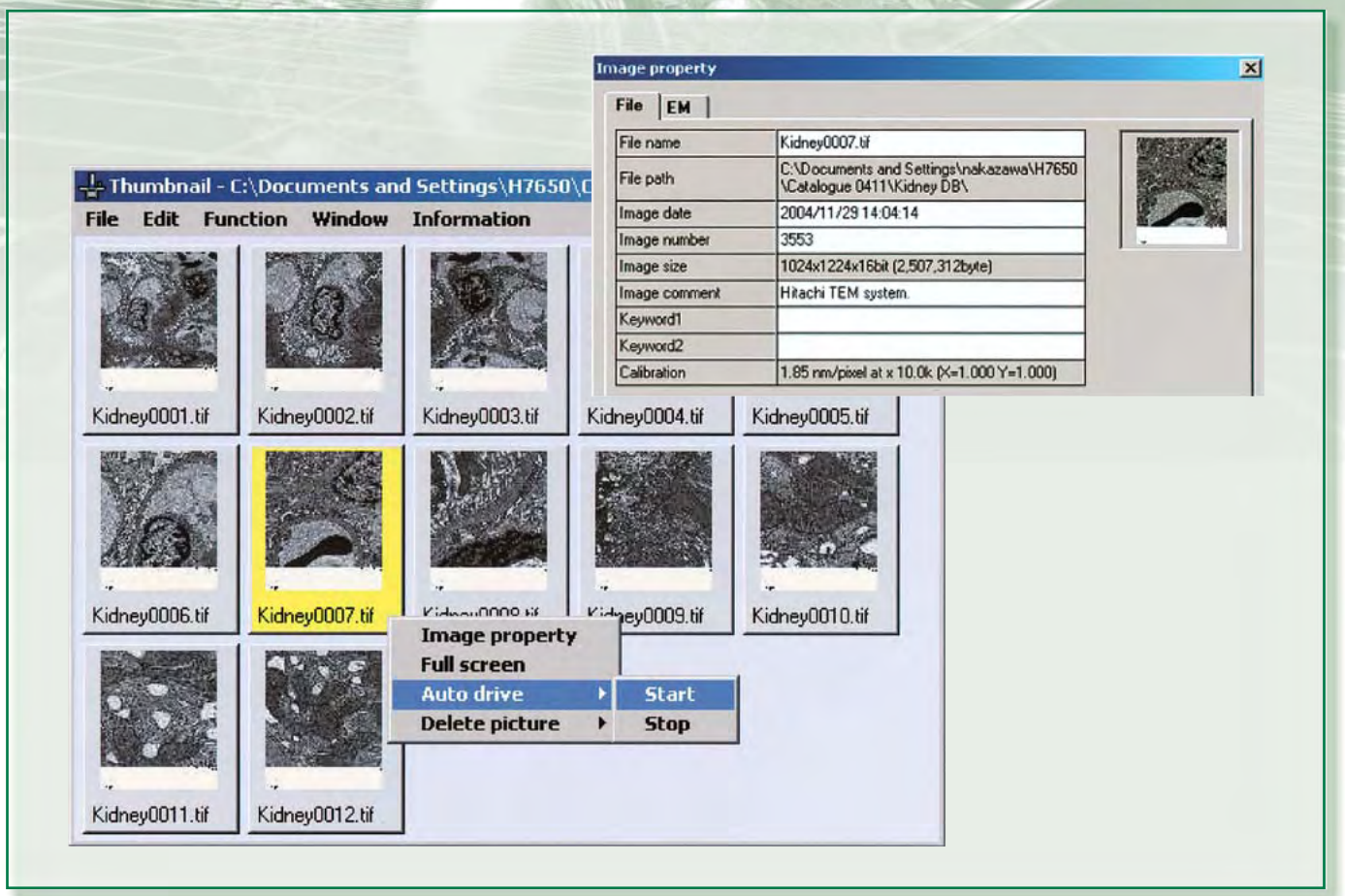
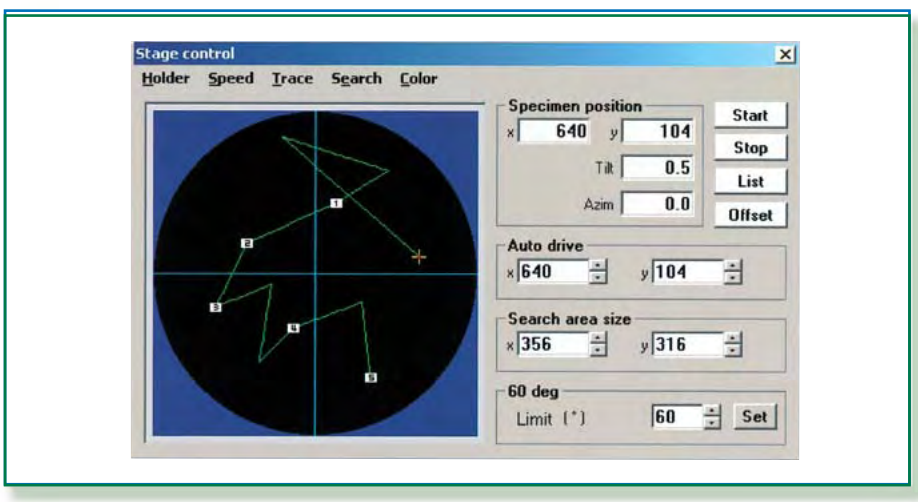


Image navigation

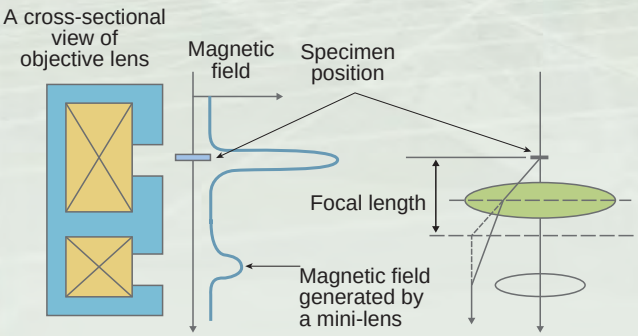
Image navigation allows the storage of specimen positions, tilt angles and orientations of up to 20 points. Stored positions can be recalled by the operator and the system drives the specimen stage to any saved point of interest. The micro-trace mode allows storage of specimen stage movements and displays the history of the stage movement. This shows the operator searched areas and unsearched areas of the specimen. Minimizing tedious work of specimen search for users.



Unique compound objective lens provides quality imaging for a wide range of magnifications

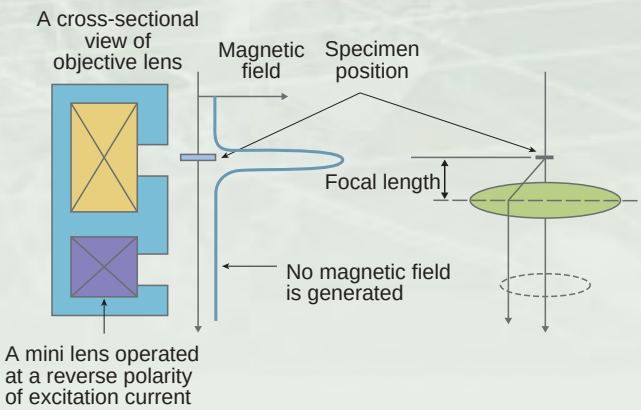
- *Hitachi's unique compound objective lens design provides two focal length settings. A long and short focal length can be selected simply by switching the polarity of the mini-lens excitation current.*
- *The long focal length setting is for low magnification and high contrast (HC) mode. The short focal length setting is for high magnification and high resolution (HR) mode. These two focal length settings are available at the touch of a button.*

Objective lens condition for HC mode



A mini lens is excited at the same polarity as the upper lens producing the magnetic field strength.
A long focal length is optimum for high contrast imaging.

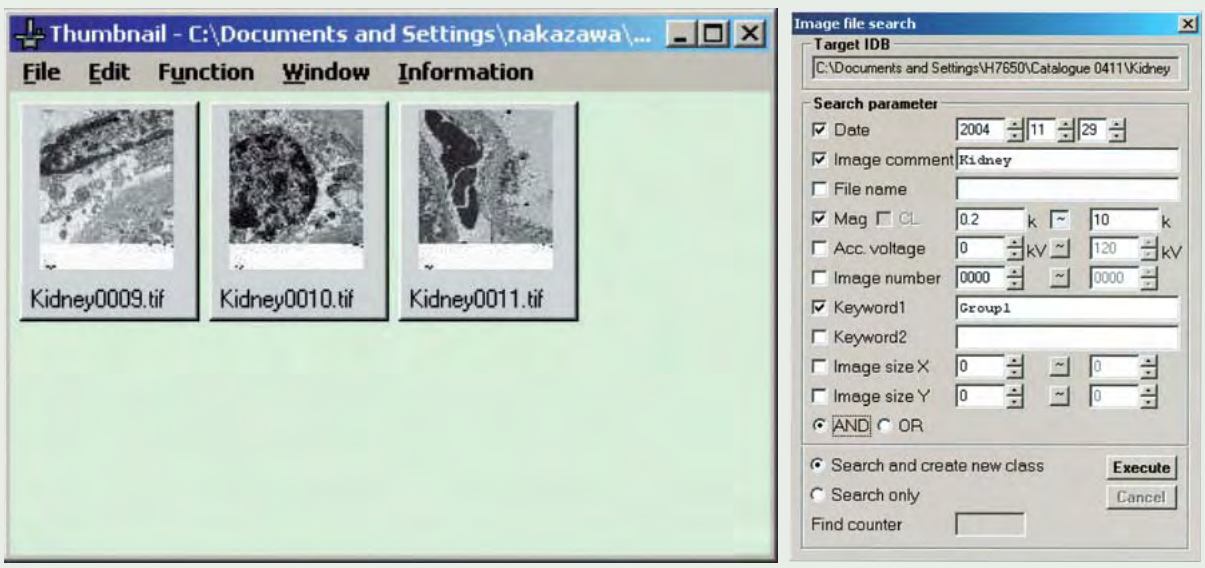
Objective lens condition for HR mode



A short focal length setting can be selected without the need to change the specimen Z-position.

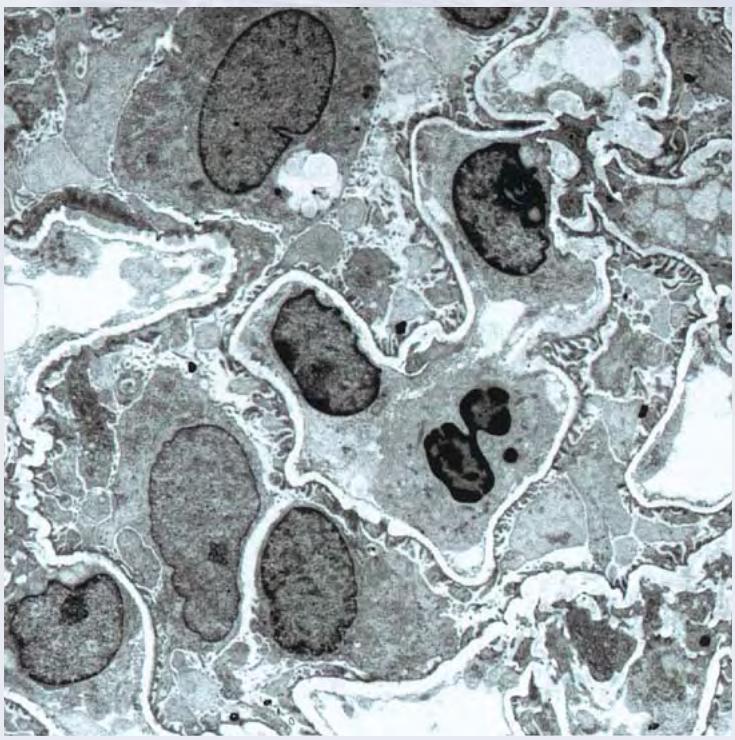
Database search function

- *A database search function is available in the H-7650 software. This allows the user to search for archived digital images recorded by the microscope.*



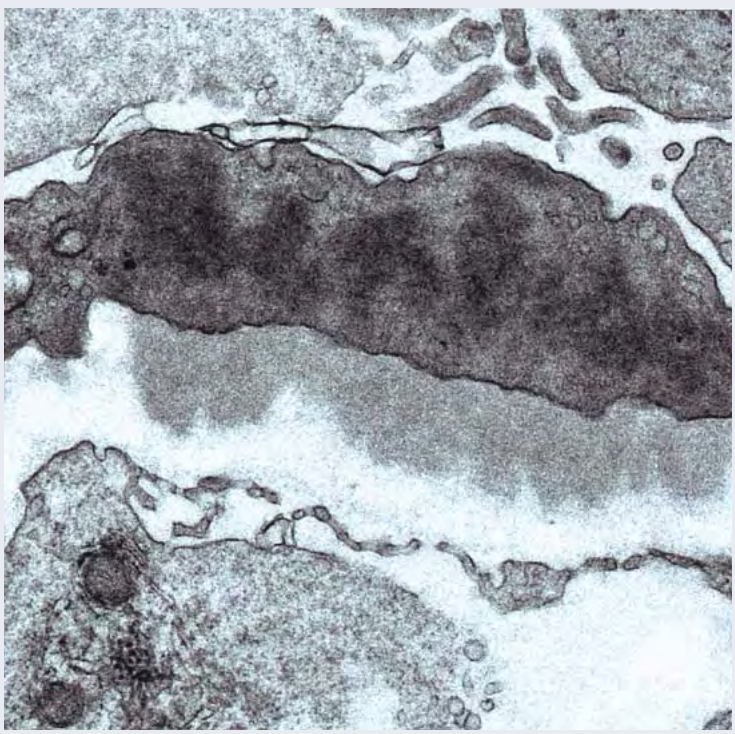
High contrast imaging of unstained specimen

Hitachi's unique compound objective lens permits high contrast observation of biological specimen. Below are micrographs of a unstained biological section recorded in high contrast (HC) mode. The specimen is a thin section of human kidney. Despite the unstained condition, the nucleus and fine blood vessels are clearly visible. On the high magnification image, the ultra-structure of the basement membrane can also be clearly observed.



Specimen: human kidney
Direct magnification: 500×
Accelerating voltage: 80kV

10μm

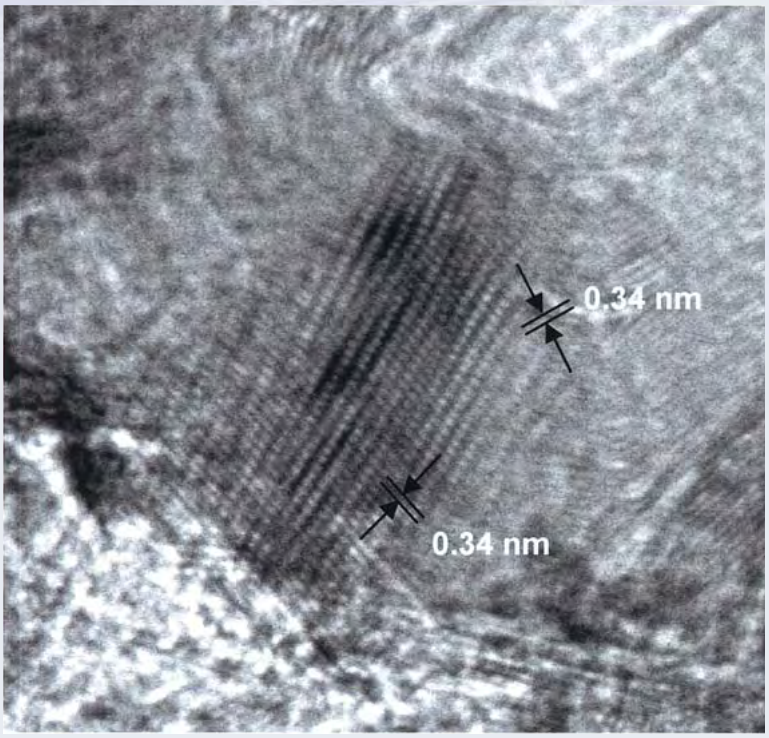


Direct magnification: 5,000×
Accelerating voltage: 80kV

1μm

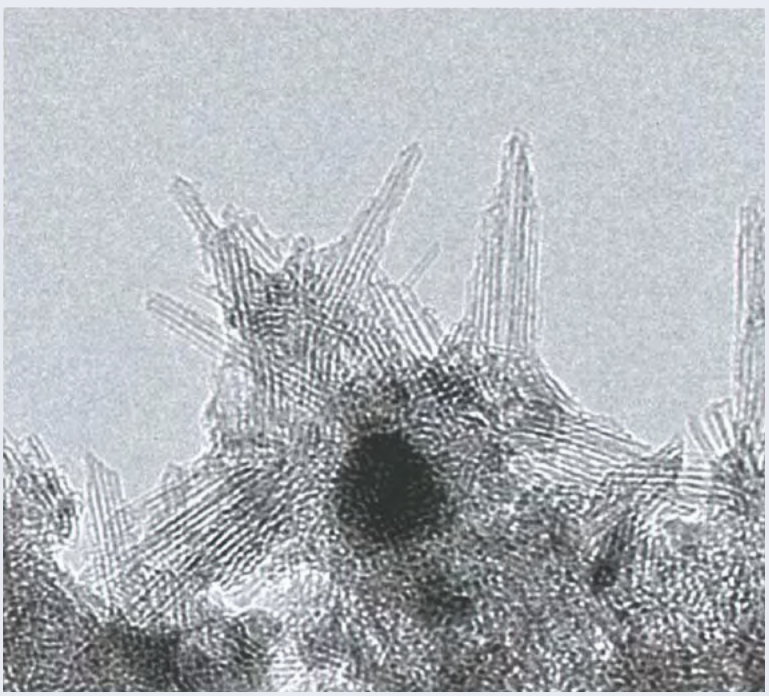
A high magnification observation of 9,500,000× is available on a monitor screen

High magnification observation is available on the monitor screen using a standard digital CCD camera. The upper micrograph is a high resolution image of graphitized carbon with a spacing of 0.34nm. The lower micrograph is also a high resolution image of carbon nano-tubes. The bundles of nano-tubes are clearly resolved.



Specimen: Graphitized carbon
Direct magnification: 300,000×
Accelerating voltage: 120kV

5nm

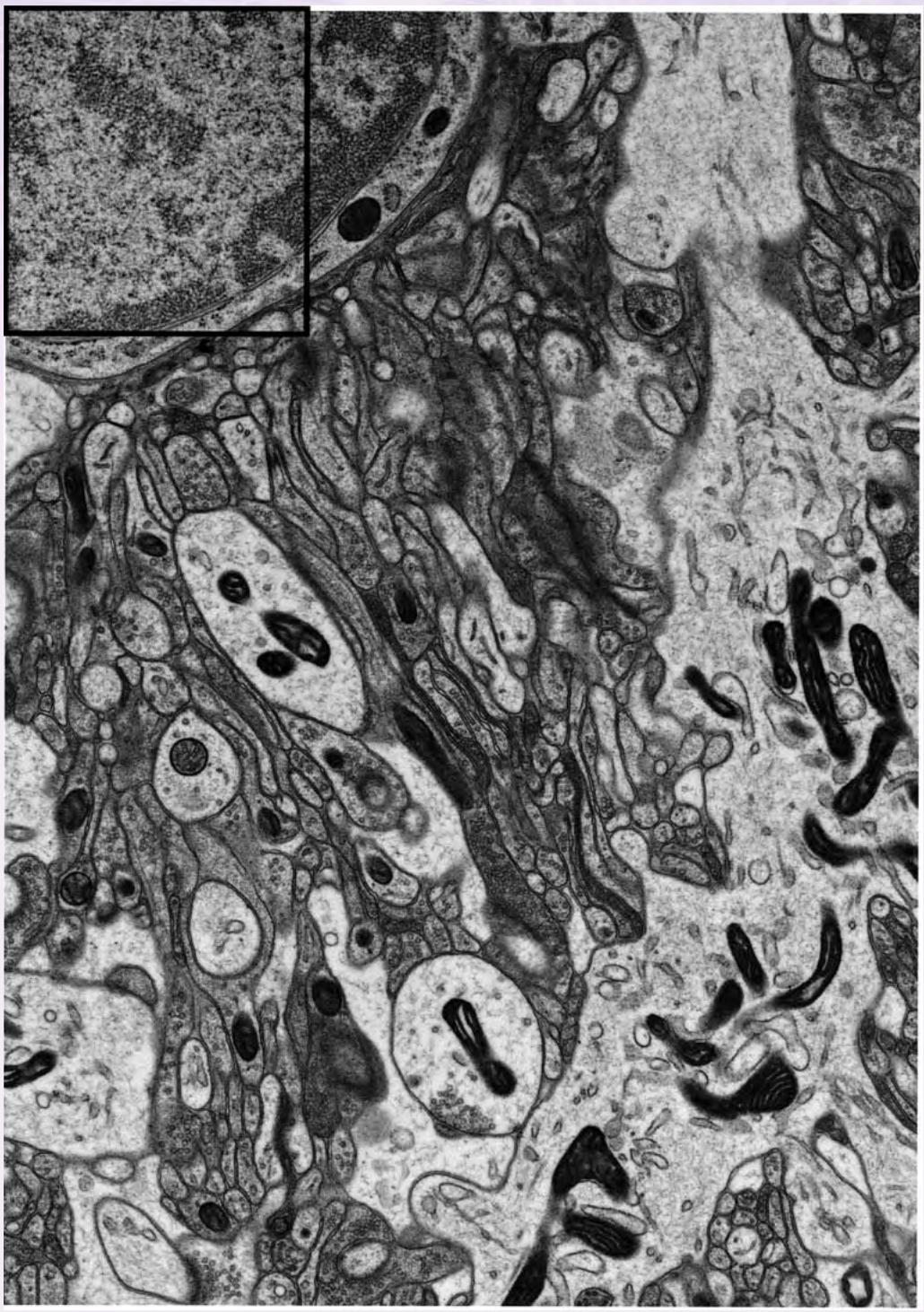


Specimen: Carbon nano-tube ,courtesy of Professor Kazuyuki Tohji, Graduate School of Environmental Studies, Tohoku University
Direct magnification: 120,000×
Accelerating voltage: 120kV

20nm

Digital auto multiple frames mode for recording high pixel resolution low magnification images

The H-7650 has a digital auto multiple frames function which allows control of the specimen stage, and digital CCD camera to automatically record images sequentially. A total of 12 exposures or 4 × 3 micrographs have been used for the large format micrograph shown below. The H-7650's lens system has been properly corrected for image distortion and peripheral blur so that all micrographs recorded with this function can be aligned properly to produce a high resolution, low magnification image.



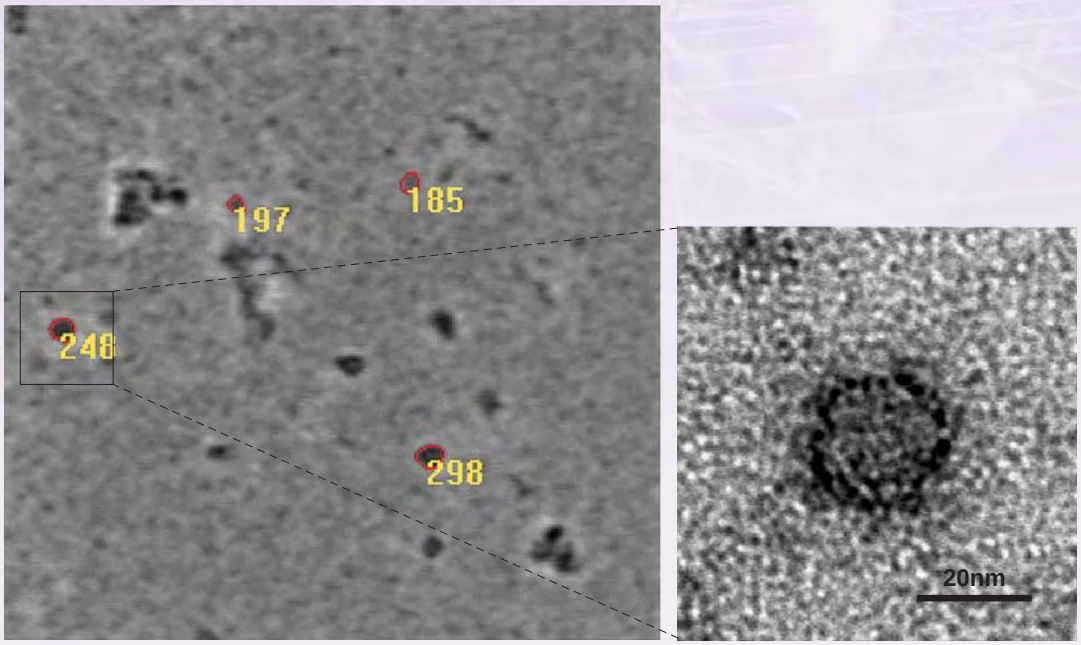
3	2	1
6	5	4
9	8	7
12	11	10

Twelve micrographs were recorded sequentially in the following order.

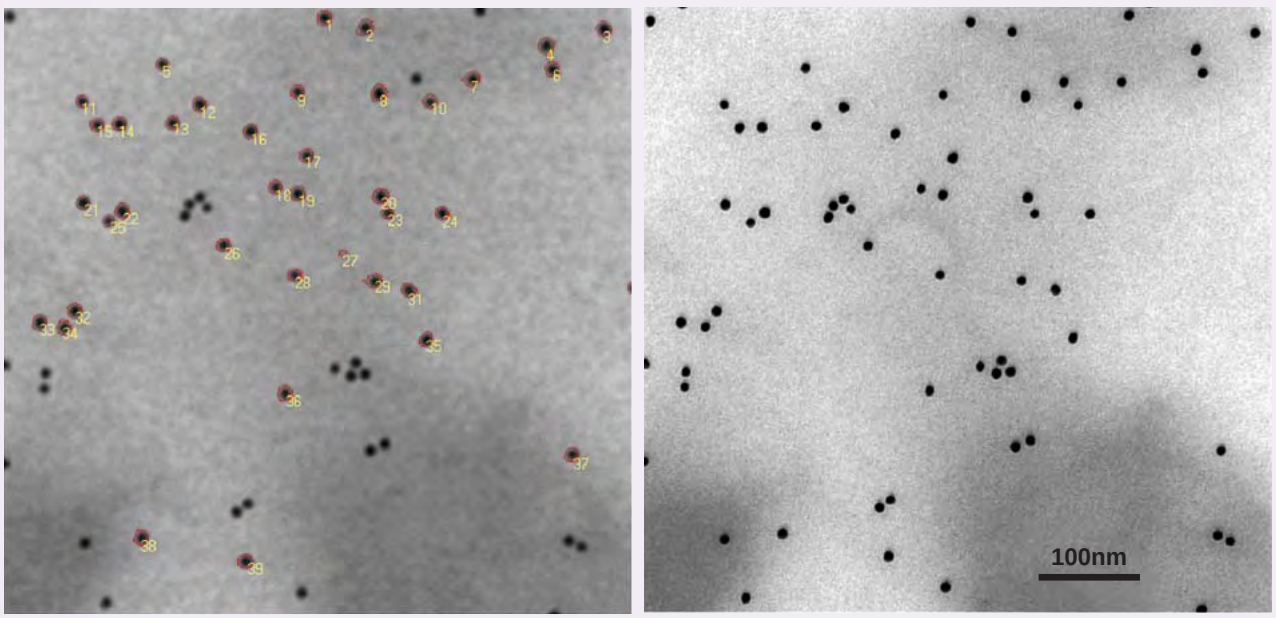
Specimen: Ultra-thin section of resin-embedded tissue of freeze-substituted rat cerebellum, courtesy of Professor Kojiro Tohyama, The Center for Electron Microscopy and Bio-Imaging Research, Iwate Medical University
Direct magnification: 7,000×
Accelerating voltage: 100kV

Automated nano-particle search

The H-7650 has an automated nano-particle search function (option) to find small nanometer size particles such as virus or other small features unattended. This function controls the specimen stage and searches for particles of interest in the selected field of view. The upper two micrographs show a typical example of a search for negatively stained SRSV (Small Round Structured Virus) in a human cell. The identical particles are marked with red circles and serial numbers. The right micrograph is a high magnification image of a particle numbered 248. This shows the fine detail of the surface structure of the virus clearly. The lower micrographs are searched examples of colloidal gold used for immune staining. A high resolution digital image is automatically recorded of the selected field.



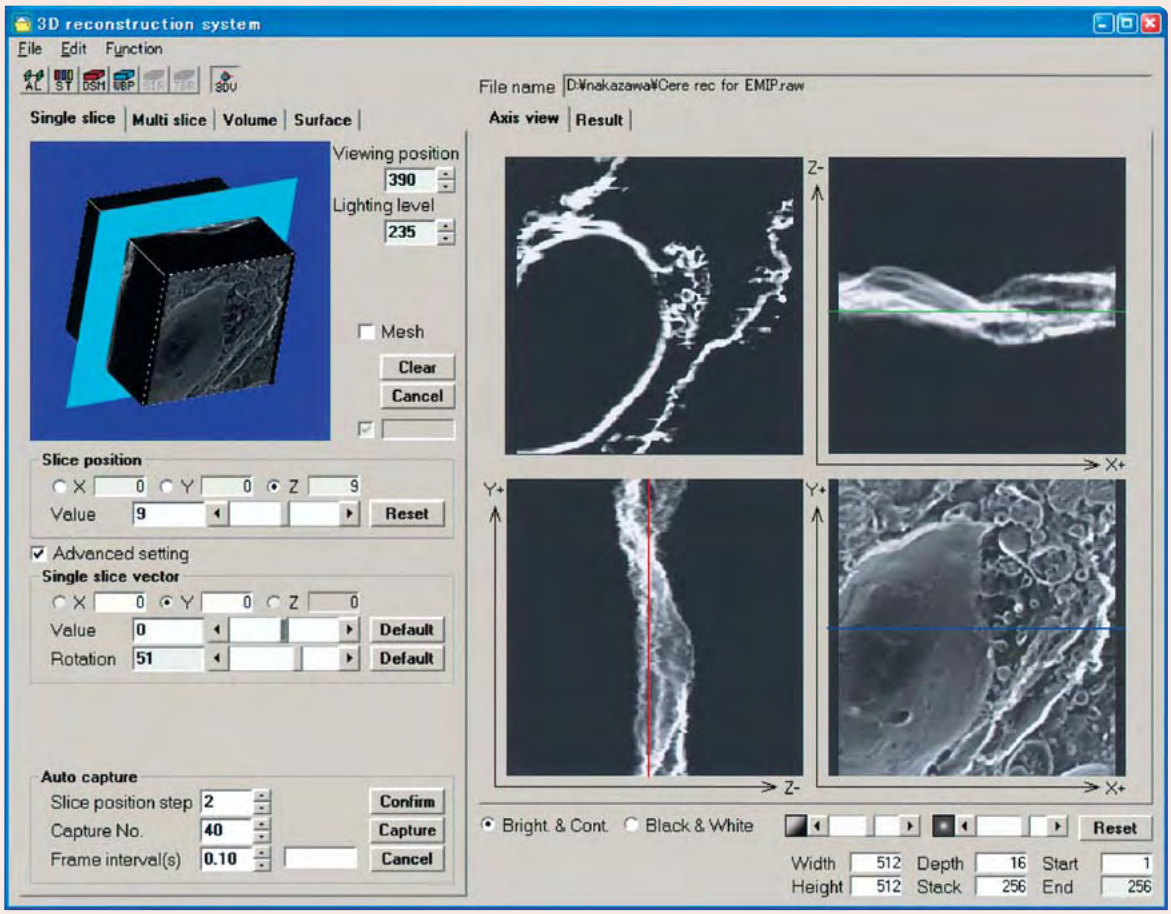
Specimen: SRSV of human, courtesy of Dr. Etsuko Utagawa, National Institute of Infectious Diseases, Japan
Direct magnification: 10,000× (left) and 50,000× (right)
Accelerating voltage: 100kV
Search conditions: Particle diameter at 30nm and elliptic rate at 1.2



Specimen: Ultra-thin section of Lowicryl K4M, courtesy of Professor Kouichi Sano, Department of Microbiology, Osaka Medical College
Direct magnification: 20,000×
Accelerating voltage: 100kV
Search conditions: Particle diameter at 20nm and elliptic rate at 1.2

Electron beam tomography

3D reconstruction using electron tomography has been pointed out as one of the leading techniques for 3D structural analysis. The H-7650 has an automatic tilt image acquisition function (option) which allows automatic TEM image recording at sequential specimen tilt angles without artifacts. Shown below is an example of a 3D reconstruction of a bovine cerebellum replica specimen using Hitachi's 3D display software (EM image prompter (option)). Sectional views of a reconstructed image are shown three dimensionally and volume rendering images viewed from X, Y and Z axes are also shown.



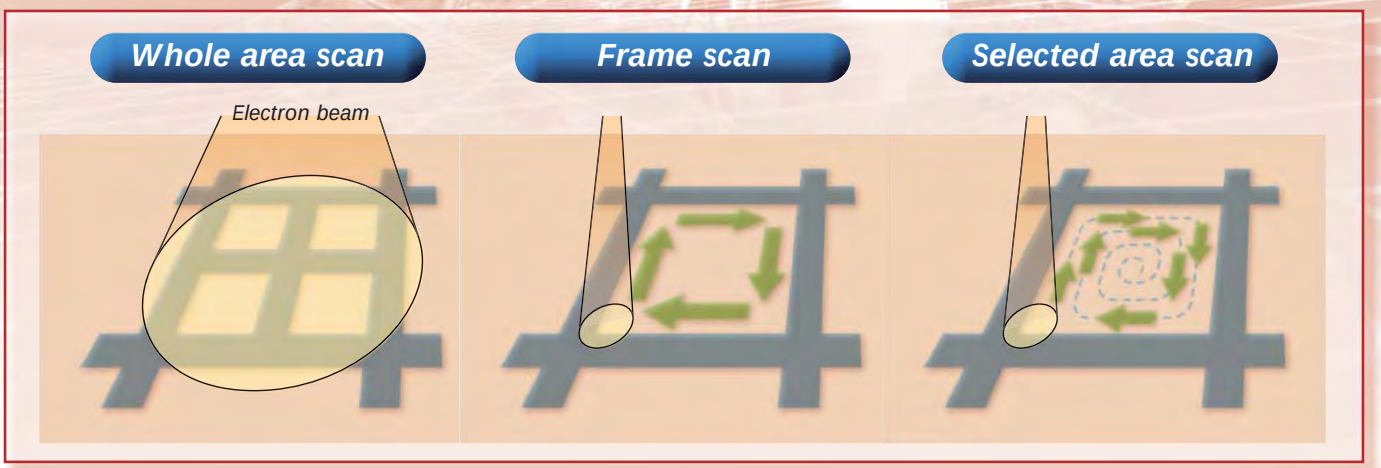
A typical 3D image display: 3D reconstructed image treated by DSM technique of quick-freeze deep-etched replica of bovine cerebellum, courtesy of Professor Eisaku Katayama, Division of Biomolecular Imaging, Institute of Medical Science, The University of Tokyo and Professor Norio Baba, Department of Electric Engineering, Kogakuin University*

**DSM: Dynamic shell modeling*

Convenient and useful functions

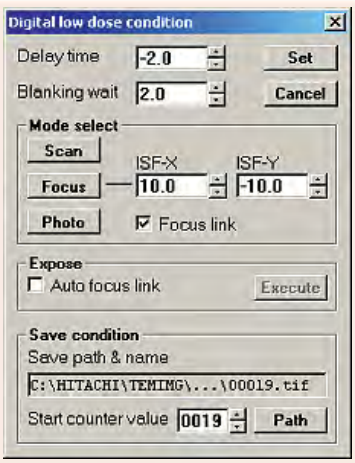
Auto Pre-Irradiation System (APIS)

The H-7650 has an auto pre-irradiation mode as standard. This mode is utilized for beam sensitive specimen or acclimating the specimen to the electron beam prior to viewing. This technique previously used by experienced operators was time-consuming and required great operator skill. The H-7650 makes this technique available to everyone which should make this method more accepted in mainstream microscopy. The system has a variety of modes including whole area scan, frame scan and selected area scan from which operators can choose to suite their specimen.



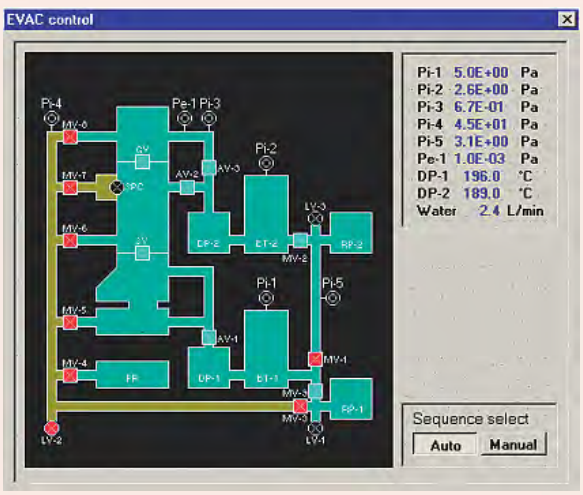
Digital low dose function

The H-7650 has a digital low dose function which minimizes the electron beam dose on the specimen. It is recommended for use with beam sensitive specimen. Allowing focusing and astigmatism correction just outside of the recording area of interest. This is particularly useful for negatively stained specimen and cryogenic specimen. In addition to the scan mode for field selection, the H-7650 has a focus mode and photo mode, which are also linked to the objective lens current.



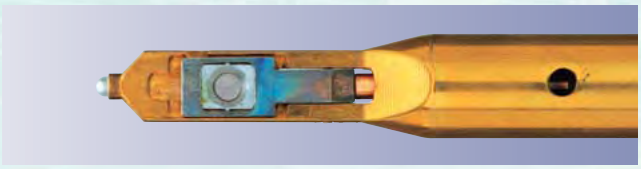
Vacuum system

The vacuum system of the H-7650 has been designed with maximum care so as to avoid any potential problems. The pre-pumping system operates gently and efficiently to protect the specimen from pre-evacuation damage. The operating conditions of the vacuum system are graphically displayed in the GUI. The differential pumping design allows operators to exchange specimen without turning off the accelerating voltage.



A variety of specimen holders are available (option)

The H-7650 has a multiple specimen holder available as an option. The three specimen holder comes with a cartridge which accommodates up to three specimen grids. The specimen position memory, micro-navigation and other unique functions are compatible with these specimen holders and facilitate the examination of specimen.

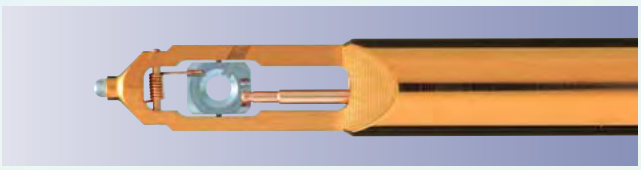


H-7502SS One-touch single tilt holder

H-7501MS Three specimen holder

H-7502MS One-touch three specimen holder

H-7502EA X-ray analysis holder



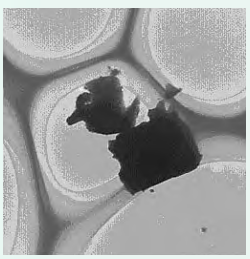
H-8101DS Double tilt holder

H-7501RS Rotation holder

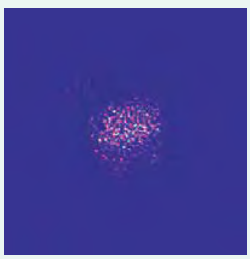
In addition to these specimen holders, various other holders such as Gatan's cryo-transfer holder are available.

Elemental microanalysis (option)

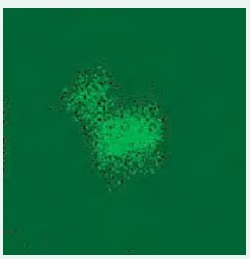
The H-7650 allows the accommodation of an energy dispersive X-ray spectrometer (EDX), permitting elemental microanalysis. The EDX detector is optimally positioned close to the specimen for high sensitivity. When coupled with the X-ray mapping function, simultaneous multiple element mapping and line analysis are available.



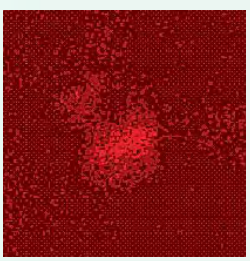
TEM image



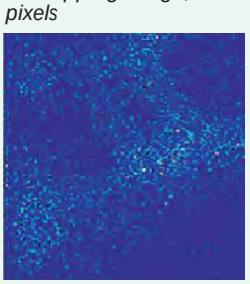
Sb mapping image, 256 pixels



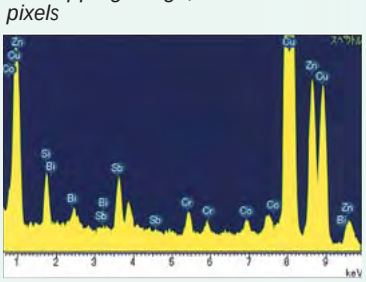
Zn mapping image, 256 pixels



O mapping image, 256 pixels



C mapping image, 256 pixels



X-ray spectrum at a time of mapping

Specifications

Resolution	0.2nm(lattice) 0.36nm(point to point)
Accelerating voltage	40 ~120kV
Magnification (on sheet film)	Zoom mode: 200× ~ 600,000× Low mag. mode: 50× ~ 1,000×
Field rotation	±90° for a magnification range of 1,000× ~ 40,000×
Digital CCD camera	Frame rate: 18 frames/sec. Image data: 1,024 × 1,024 pixels, 12 bits
Automated functions	Auto focus, Auto stigmator, Digital auto photo, Digital auto multiple frames, Auto drive
Image functions	Image processing, Image management, Measurement
Low dose mode	Digital low dose APIS (Auto Pre Irradiation System)
Illumination lens system	
Condenser lens:	2 stages
Movable aperture:	20, 50, 100, and 200 microns (Click stop 4 aperture openings)
Specimen stage	Side entry eucentric goniometer stage
Stage traverse:	X, Y : ±1mm (Motor drive with CPU control) Z : ±0.3mm
Maximum tilt:	±20° or ±60° (option)
Functions:	Image navigation Specimen position memory
Image formation lens system	
Compound objective lens:	T-block lens Focusing step is linked with working magnifications
Objective aperture:	10, 20, 50, and 80μm (Click stop 4 aperture openings)
Focus aid:	Image wobbler Stigmonitor for focus and astigmatism correction Optimum underfocus: 3 channels (OF-1, 2 and 3) linked with working magnifications Magnification wihtout image rotation for each observation mode (±5° or less)
Intermediate lens:	2 stages with stigmators
Projector lens:	2 stages
Viewing chamber	
Fluorescent screen:	160mm for observation 33mm for focusing (works for a spot exposure meter) Screen operation (up and down) is motorized.
Exposure meter:	Electron beam detection with green light for optimum conditions
Vacuum system	In-column liner tube design Fully automated sequence control with vacuum sensors
Pumps:	Two diffusion pumps (570 L/s × 2) and two rotary pumps (160 L/s × 2)
Vacuum sensors:	Pirani gauge ×5 and Penning gauge ×1
System protection	Microscope system has been protected against power, water, DP overheating, high voltage discharge, overheating of power transistors, and malfunctions of vacuum sequence.
Note: Other cameras such as 2k × 2k or 4k × 4k CCD camera's are available. Some of the functions described in this brochure may not be applicable. Please consult with your local Hitachi representative.	
Dimensions & weight	
Column:	180(W) × 120(D) × 220(H) cm, 930kg
Power supply:	70(W) × 38(D) × 84(H) cm, 150kg
High voltage transformer:	69(W) × 38(D) × 70(H) cm, 190kg
Rotary pump:	17(W) × 59(D) × 27(H) cm, 30kg × 2 sets
Air compressor:	64(W) × 28(D) × 53(H) cm, 27kg

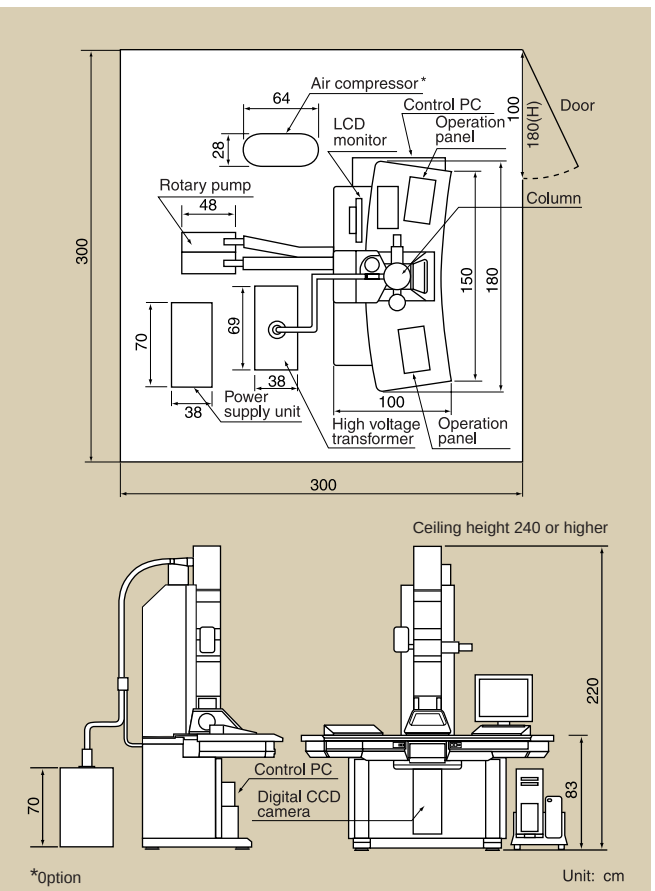
Optional accessories

- LaB_6 emitter
- Film camera
- Multi-frame unit for sheet film camera
- Automated particle search
- Automatic tilt image acquisition
- 3D-reconstruction software
- Selective area aperture
- TEM X-ray mapping
- EDX system
- Track ball
- Cold finger
- Cold trap
- Dry vacuum system

Installation site conditions

Power	Single phase AC 100,115,200,220,240V, 50/60Hz, 6.0kVA
Voltage stability	±10% or better
Grounding	Independent grounding with a resistance of 100Ω or better
Cooling water	
Temperature:	10 ~ 20°C (Stability at ±0.1°C or better)
Flow:	2 ~ 3 L/min (2 lines)
For closed water circulator:	12.6MJ/h
Pressure:	0.05 ~ 0.2MPa
Faucet:	Rc 3/8 (female) × 2 pcs
Drain:	Natural drain on the floor level × 2 pcs
Stray magnetic field	0.10μT or less
Floor vibrations	5Hz or lower 0.4μm p-p or less 5Hz ~ 10Hz 1.0μm p-p or less 10Hz or higher 3.0μm p-p or less
Room	
Temperature:	15 ~ 25°C
Humidity:	30 ~ 60%RH

Typical installation site



NOTICE: For proper operation, follow the instruction manual when using the instrument.

Specifications are subject to change with or without notice.

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