

Medical & Electronic Equipment

Healthcare Systems

Biotechnology and Scientific Instruments

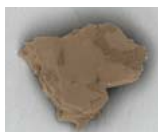
Semiconductor Manufacturing
and Inspection Equipment

Electronic Equipment



Curation Equipment for Analyzing Particles Retrieved from Itokawa Asteroid by Hayabusa Probe

The Hayabusa asteroid probe returned to Earth from its seven-year journey through outer space in June 2010. The mission succeeded in returning samples from the Itokawa asteroid, the first time in human history that such a feat had been achieved, other than from the Moon. The international attention that this success received remains fresh in the memory. The final task of the project was undertaken by Hitachi and involved the development of curation equipment for recovering the precious samples for initial analysis and distribution to analytical laboratories. This article talks to the development team about how they went about developing this important equipment of a type that had never before existed.



Particles collected from the Itokawa asteroid (photographed by S-4300SE/N SEM)
Source: JAXA curation public web site for international research

Dependence of Scientific Results on Curation Equipment

While the technology associated with the spacecraft itself tends to dominate attention when considering the technology behind the Hayabusa project, the curation* equipment used to recover the returned samples, conduct the initial analysis, and distribute the samples to analytical laboratories also plays an essential role in producing scientific results.

The initial inquiry by the Japan Aerospace Exploration Agency (JAXA) asking whether Hitachi could build such equipment was made to Hitachi Plant Technologies, Ltd., a company that has extensive experience in the construction of clean rooms, in 2002. To meet JAXA's requirements, Hitachi determined that a range of different technologies would be required, including scanning electron microscopes (SEM) and ultra-high vacuum technology. A team was formed, led by Hitachi High-Technologies Corporation and also including Hitachi, Ltd.'s Central Research Laboratory and Hitachi Plant Technologies, Ltd., to bring together Hitachi technology for application in the development of the equipment.

Creation of Contamination-proof Environment

The fundamental and most important requirement in the development of the curation equipment was to prevent contamination of the sample by terrestrial material. Potential contaminants included not only dust, but also oxygen, moisture, and gaseous organic compounds derived from petrochemical products. A clean chamber, made of inorganic metal materials and able to support both an extremely pure nitrogen gas atmosphere at atmospheric pressure and an ultra-high vacuum equivalent to that in space, was installed in a clean room with a level of air purity equivalent to a semiconductor plant. The design of the chamber allowed the capsule to be opened inside it to recover, observe, and separate the samples. The SEM for performing the initial analysis of the samples has a specimen stage made specially of materials that will not contaminate the samples and a custom design that allows observations to be performed without holding the samples in place, and in a low-vacuum nitrogen atmosphere.

Because this equipment is unlike anything that has been made before, all of the systems were developed by trial and error. Development completed in March 2008. The next two years were spent verifying its overall performance and functions. To monitor conditions inside the equipment, Hitachi's high-precision mass spectrometer was used to underpin the level of cleanliness. Also,

not only did all of the equipment have base-isolated structures, the clean chamber was independent of its base and was unaffected by the Great East Japan Earthquake.

Showcase of Monozukuri Technologies

The Itokawa samples consisted of particles with sizes in the order of micrometers, considerably smaller than was originally predicted. In addition to the technologies described here, recovering this material under circumstances that would be unforgiving of any mistakes required the application of a wide range of other technologies, such as advanced precision machining techniques. The curation equipment is a veritable showcase for the detailed technologies built up by Hitachi in the field of monozukuri (manufacturing), and Hitachi is proud to have contributed to the Hayabusa project in such a capacity.

The technology developed for the custom SEM is already being applied in an atmosphere isolation system for industrial electron microscopes. In the future, Hitachi intends to continue contributing to leading-edge science and applying its energies to making use of the knowledge it obtains in the process.

* The term "curation" used here derives from the word's meaning in the context of cultural institutions whose purpose is to preserve artifacts, such as museums, art galleries, libraries, and public records offices in the USA and Europe, where it refers to assessment of and research into their collections of artifacts and the use of specialist academic knowledge in the management and administration of these tasks.



From front-left: Mikio Takagi, General Manager; Tsutomu Tanaka, Manager; Hisanori Torii, Assistant Manager, Science Systems Sales Dept. 2, Science Systems Sales & Marketing Division, Science & Medical Systems Business Group, Hitachi High-Technologies Corporation. From left-rear: Osamu Muto, Manager, Kanagawa Technology Group, Equipment Business Department, Environmental Systems Division, Hitachi Plant Technologies, Ltd.; Hiroshi Abe, Manager, Open Innovation Promotion Department, Technology Strategy Office; Hiroyuki Nishihara, Engineer; Akihiro Furukawa, Engineer, Advanced Trial Development Center, Central Research Laboratory, Research & Development Group, Hitachi, Ltd.

SCENARIO 64-slice CT System with Leading-edge Technology

The SCENARIO* is a 64-slice computed tomography (CT) system that uses leading-edge technology to achieve low exposure and high image quality. New function of exposure dose reduction is a low-dose, low-exposure technique that uses both lateral sliding movement of the patient table and a dedicated low-dose bow-tie filter to reduce X-ray exposure.

The SCENARIO uses the iterative processing method to improve image quality. This involves an iterative noise reduction process that extracts reliable statistical data from the image data space and projection data space in turn to achieve an optimal balance between granularity, sharpness, and image noise in each region.

Another feature of the SCENARIO is its 10.4-inch (26.4 cm) touch vision multi-function monitor that can display warning messages in 10 different languages to suit patients from a variety of countries. It is also used to display patient positioning information.



SCENARIO 64-slice CT system and touch vision screen

These features make the SCENARIO 64-slice CT system a precision scanner that is easy to use and comes with leading-edge technology.
(Hitachi Medical Corporation)

* SCENARIO is a trademark of Hitachi Medical Corporation.

Digital Diagnostic Ultrasound System

The HI VISION series digital ultrasound systems were developed with state-of-the-art technologies and represent the culmination of collaboration within Hitachi's network of research laboratories. The HI VISION Ascendus* is our latest high-end system and expands our product portfolio at the premium end.

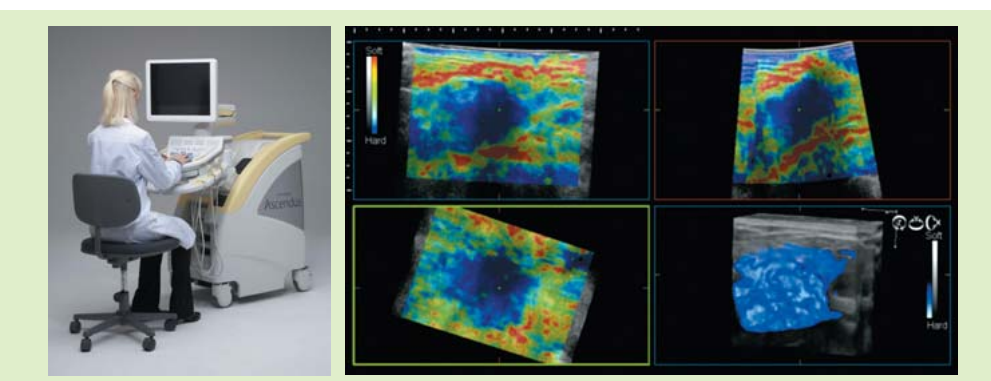
The main feature of this system is realtime tissue elastography. As palpation shows, stiffness provides practical information for diagnosis. In our system, gentle compression is applied to tissue

and the resulting strain or displacement is calculated from the change in echo signals before and after applying compression. This is displayed as a color overlay on a conventional B-mode ultrasound image.

Moreover, the HI VISION Ascendus supports new leading-edge technologies and is the first such product in the world that can display the distribution of strain three-dimensionally in realtime (realtime 3D display of elastographic images).

Elastography has been recognized as a useful tool for breast tumor diagnosis. Studies are currently ongoing in other areas, including the liver, pancreas, and skin. It is hoped that applications of this technique can be expanded into new areas.

(Manufactured by Hitachi Medical Corporation
Distributed by Hitachi Aloka Medical, Ltd.)



Outlook of HI VISION Ascendus and an example realtime 3D display of elastographic images (blue indicates hard regions and red indicates soft)

* Ascendus is a trademark of Hitachi Medical Corporation.

SU9000 Ultra-high-resolution Scanning Electron Microscope for Latest Nanotechnology Research

Scanning electron microscopes (SEMs) are used in a wide range of fields including the latest semiconductor devices and nanotechnology materials.

The SU9000 features the world's highest level of resolution at 0.4 nm (30 kV: SE image, as of August 2011). It also incorporates a new cold field emission (FE) electron source suitable for ultra-high resolution observation, which delivers images with greater brightness and superior signal to noise ratio (S/N) than previous electron source. Also, the performance of Hitachi's proprietary in-lens objective lens has been improved to 1.2 nm at low acceleration voltage (1 kV), while the scanning transmission electron microscope (STEM) resolution at high voltage (30 kV) (option) is guaranteed by a graphite lattice [C(002) $d = 0.34$ nm]. The SU9000 also features a proprietary signal detection system that provides a high level of contrast for different types of observation, such as shape or composition assessment. Meanwhile, a new interface designed for better usability provides the operator with an environment that is easy to use. (Hitachi High-Technologies Corporation)

(Release date: April 2011)



SU9000 ultra-high-resolution scanning electron microscope

New High Performance Liquid Chromatograph

High performance liquid chromatograph (HPLC) is widely used for the measurement of composition and the constituent quantities of liquid-soluble substances in industrial research and devel-

opment, quality control, and other applications that involve pharmaceutical, food, chemical, or environmental analysis.

The new HPLC belongs to the conventional model category, the most common of the various different types of HPLC. This means it needs to demonstrate all-round capabilities in terms of its core performance, ease of operation, and robustness. The pump incorporates a new gradient mode called a high frequent mode, the autosampler features a high precision syringe drive unit, and core performance factors, including reproducibility, sensitivity, and stability, have been enhanced by making further improvements to the noise and drift performance of the detector. Meanwhile, ease-of-use has been improved by the adoption of a new controller that incorporates a touch panel that achieves an automated instrument startup/sleep procedure. The robustness of the instrument has also been enhanced thanks to features such as the properties of the external cover and inner wall, an autosampler door lock mechanism designed for safety, and a leak sensor even in the column oven.

The HPLC went on sale internationally in February 2011.

(Hitachi High-Technologies Corporation)



New controller incorporating a touch panel

New Model Advanced High Resolution CD-SEM "CG5000"

Various fine patterning techniques have been implemented in the semiconductor industry, such as double patterning (DP) technology utilizing immersion lithography and extreme ultraviolet

(EUV) technologies, to enable the continued shrinking of semiconductor devices.

To support these technologies, Hitachi has announced the release of its newest model of advanced high-resolution critical dimension scanning electron microscope (CD-SEM). Hitachi's CG5000 maintains high repeatability (0.25 nm) while suppressing the effects of the electron beam on the sample, such as resist shrinkage, through variable magnification scanning. The CG5000 also supports the latest lithography technologies, like optical proximity correction (OPC), which is used to maintain pattern fidelity. The CG5000 is equipped with a high speed scanning capability enabling precise contour extraction as well as the evaluation of discrepancies between contours and the corresponding simulations. In its basic performance, the CG5000 achieves high resolution (1.45 nm with image enhancement) and high throughput (50 wph)* to further improve productivity in response to the measurement needs of the next generation 1X nm technology nodes. (Hitachi High-Technologies Corporation)

* Equipment performance values are used Hitachi standard wafer.



New model advanced high resolution CD-SEM "CG5000"

Non-volatile Material Etch System "E-8410"

Industrial development of highly functional next-generation non-volatile memory technologies is currently accelerating at a significant pace.

Hitachi High-Technologies Corporation has developed a new 300-mm-capable dry etch system E-8410, designed specifically to etch the non-volatile materials used in manufacturing these next-generation memory devices.

<Key features>

- (1) Electro magnetically coupled plasma (EMCP) technology provides excellent etch profile control and outstanding uniformity.
 - (2) E-8410's unique cleaning technology allows for superior mean wafers between cleaning (MWBC) and process stability required for mass production.
- (Hitachi High-Technologies Corporation)



Non-volatile material etch system "E-8410"

Mass Production Technology for Low-temperature SiGe SEG



QUIXACE load lock batch thermal process system

Technology for selective epitaxial growth (SEG) of silicon germanium (SiGe) films at low temperature has attracted attention for its potential to deliver further improvements in the performance of semiconductor devices. This low-temperature SiGe SEG technology can be used, for example, to form SiGe [which has a higher lattice constant than silicon (Si)] in the

source and drain regions of a transistor, thereby improving hole mobility by stressing the Si channel region.

To allow this technology to be adopted for mass production at semiconductor fabrication plants, Hitachi has developed mass production technology for low-temperature SiGe SEG using the QUIXACE* load lock batch thermal process system, which is already in widespread use. By ensuring rigorously high levels of cleanliness in the reaction atmosphere, and by optimizing the process to suit mass production, the technology is able to deliver excellent results in terms of reproducibility, film thickness uniformity, and productivity.

In the future, Hitachi intends to contribute to further advances in semiconductors by extending the low-temperature SEG mass production technology to allow use with films other than SiGe. (Hitachi Kokusai Electric Inc.)

* QUIXACE is a trademark of Hitachi Kokusai Electric Inc.

H.264 Ultra-low-delay HD Codec for Broadcasting and Medical Applications

The H.264 ultra-low-delay high-definition (HD) codec is a video codec developed for broadcasting and medical applications. It performs video compression with high quality and minimum delay. The total codec delay time (time from video input to video output) of at least 8 ms eliminates any perceived delay when the video output from the codec is displayed.

Opportunities for the use of video in medical applications are increasing. While the high volume of video data makes use of video compression important, a problem with this is that codecs typically insert a delay of between several 100 ms and several seconds.

Typical medical applications for video include remote opera-

tion and remote consultations. As these involve operating equipment or holding a conversation, any processing delay can make video difficult to use. In cases where this delay made use of video compression impractical and the transmission of large volumes of data is required, it is now possible to use the codec to cut bandwidth requirements significantly. This also opens up the potential for use of video in applications that were not practical in the past.

The codec is suitable for use over Internet protocol (IP) networks as well as coaxial cable. While use of IP networks requires consideration of network delay, it also simplifies the task of configuring video transmission systems. (Hitachi Kokusai Electric Inc.)

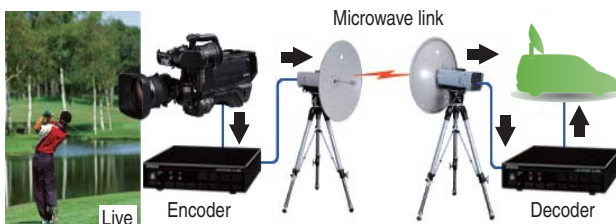


Encoder

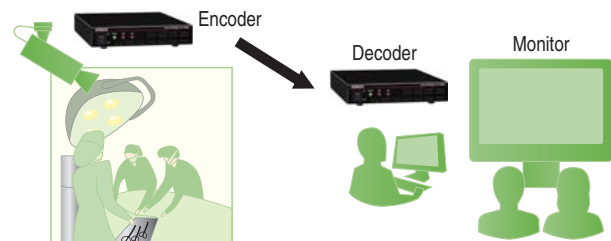


Decoder

Live sports broadcast



Medical application (remote consultation)



Encoder and decoder (top) and application (bottom)

Lithium-ion Battery-operated Electronic Pulse Driver “WM14DBL”

Hitachi released the “WM14DBL” lithium-ion battery-operated electronic pulse driver that provides quiet operation and can be used for a wide range of tasks. Major features are as follows:

(1) An original electronic pulse system is employed that performs clockwise rotation, pause, counterclockwise rotation, and pause of a direct current (DC) brushless motor at high-frequency, achieving super quiet operation, about 1/25 (68 dB) of a similar tool, an impact driver.

(2) Operating modes can be switched easily with dial operation, this product is optimally controlled with electronic control, and it can be applied to various tasks such as tightening wood screws and bolts that require high torque, tightening small screws that require fine adjustment, and drilling.

(3) Supports applications that require optimal tightening control such as for installation of solar panels and assembly of automobiles.

(Hitachi Koki Co., Ltd.)



Installation of solar panels

Assembly of automobiles

Lithium-ion battery-operated electronic pulse driver “WM14DBL” and examples of application

Lithium-ion Battery-operated Cordless Grasstrimmer “CG14DSDL”

Hitachi released the “CG14DSDL” lithium-ion battery-operated cordless grasstrimmer that combines a high-efficiency disk motor

and a high-capacity lithium-ion battery. Major features are as follows:

(1) Since a disk motor is located just above a trimmer to directly rotate the trimmer, transmission loss of power is low, achieving continuous operating time of about 20 to 40 minutes, two times longer than conventional products.

(2) Super quiet operation is achieved about 1/80 (72 dB) of the operation sound of engine grasstrimmer.

(3) Powerful trimming, equivalent to an engine grasstrimmer, is possible by boosting the voltage of 14.4-V lithium-ion battery to 38 V.

(4) It is a zero emission tool that is battery-operated.

(Hitachi Koki Co., Ltd.)



Disk motor

Lithium-ion battery-operated cordless grasstrimmer “CG14DSDL”