Electronic Systems & Equipment

- Biotechnology and Scientific Instruments
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- Electronic Equipment
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Chairman of the Board Hidehito Obayashi of Hitachi High-Technologies Receives the IEEE Ernst Weber Engineering Leadership Recognition Award

Chairman of the Board Hidehito Obayashi (President, Chief Executive Officer and Director at the time of this interview) of the Hitachi High-Technologies Corporation has been presented by The Institute of Electrical and Electronics Engineers, Inc., in the USA with the Ernst Weber Engineering Leadership Recognition award, which is given to individuals in recognition of their contributions to the development of electrical engineering, electronics, information, and communications fields. Chairman Obayashi developed the world's first CD-SEM in the 1980s, opening a path towards the miniaturization of semiconductors by enabling the measurement of minute circuit patterns on semiconductor devices. In recognition of this achievement, Chairman Obayashi became the first Japanese recipient of this award.

The S-6000, first CD-SEM in the world (1984) (left), and the CG4100, the latest model (2009) (right)

Major Achievements in the Fields of Electrical Engineering, Electronics, Information, and Communications

The Institute of Electrical and Electronics Engineers, Inc. (IEEE) is the largest international engineering society devoted to promoting technological innovation in the fields of electrical engineering, electronics, information, and communications. In addition to its standardization efforts, the IEEE also carries out a wide range of activities that emphasize the cultivation of technological innovation, related industries, and human resources, including recognizing the contributions of individuals and corporations in related fields every year.

The 2010 IEEE Ernst Weber Engineering Leadership Recognition award I received is given to individuals who have supported advances in the fields of electrical engineering, electronics, information, and communications, from a position of international leadership. This award was first established in 1985, and its name was changed to the current name in 1996 to honor the first president of the IEEE, Ernst Weber. In the past, leaders of world-renowned corporations such as Dr. Andrew S. Grove of Intel Corporation have received this award, and I am both deeply honored to be the first Japanese recipient named, as well as profoundly humbled.

A Paradigm Shift that Broke through the Wall of Miniaturization

This award was given in recognition of contributions to the miniaturization of semiconductors that were made possible through the development and popularization of CD-SEMs (critical dimension scanning electron microscopes). The development of CD-SEMs began back in the 1980s, while I was researching lithographic technology for semiconductors at the Central Research Laboratory of Hitachi, Ltd. At the time, the dimensions of semiconductor circuit patterns were measured with optical microscope technology, but in order to break through the minimum line width of 1 μm and continue miniaturization, measurement tools with a higher resolution were required. It was at this point that I wondered whether or not we could use SEMs. Incidentally, to use extremely delicate SEM devices at a semiconductor manufacturing environment to measure length, in spite of the fact that SEMs were not originally designed for this purpose, was considered to be an impossible idea at the time. Of course, the development process involved a large number of difficulties, but as a result, there has been a paradigm shift whereby electron microscopes are no longer seen as just advanced scientific analysis tools, but rather as industrial measurement tools as well. The application of SEMs has completely transformed the world of semiconductors, by enabling a giant leap forward in miniaturization.

Our CD-SEMs, which we have continued to develop ever since the first commercialized version by always listening to and incorporating the voice of the customers, have become indispensable measurement tools for the development of semiconductor device miniaturization technology and the management of fabrication yield in the mass production line.

Passing the "Pioneering Spirit" on to the Next Generation

It goes without saying that this prestigious award was not achieved solely through my own efforts. I would like to thank our customers who use CD-SEMs throughout the world, as well as Hitachi's developers, sales and marketing personnel, and service personnel, who have diligently listened to the voice of each customer. At the same time, I would also like to note once again the vital importance of the "Pioneering Spirit" that permeates Hitachi, and which led to the development of the CD-SEM.

Here at Hitachi High-Technologies Corporation, we solicit challenging project ideas from within the company as well as the Hitachi Group, and carry out activities in support of the research and development of selected ideas and the creation of new businesses. My hope is that through these activities we can pass the Pioneering Spirit on to the next generation, while continuing to take on our mission to contribute to society with advanced technologies.

Hidehito Obayashi, Chairman of the Board (President, Chief Executive Officer and Director at the time of this interview), Hitachi High-Technologies Corporation

U-5100 Spectrophotometer Based on the Eco-friendly & Clean Concept

A spectrophotometer is a device for researching the characteristics of a sample by illuminating it with monochromatic light and analyzing the light that passes through it (or is absorbed by it). Spectrophotometers are utilized in many industries, including biotechnology, environmental science, and chemistry. This new U-5100 model is classified as belonging to the category of spectrophotometers that includes the most compact and basic models.

The U-5100 was designed with a focus on the eco-friendly & clean concept. By employing electricity-saving and long-life xenon flash lamps, Hitachi has been able to achieve high-quality design characteristics, including light weight and compactness, as well as low electricity consumption and low operating costs when compared with existing devices. In addition, newly developed light detection circuits and six automatic cell turrets have been added to improve basic performance and operability as an analytical device, ensuring high levels of both environmental efficiency and basic performance (the U-5100 was released in April 2010).

Eco-friendly & clean spectrophotometer model U-5100

Characteristics of the U-5100 spectrophotometer:

(1) Uses long-life and energy-saving xenon flash lamps.

(2) Lightweight, compact, and designed for high usability

(3) Lowest noise level among equivalent products*

(4) Comes standard with six automatic cell turrets, ensuring a high level of operability.

(Hitachi High-Technologies Corporation)

* As of January 2010, based on testing performed by Hitachi High-Technologies Corporation.

HT7700 Transmission Electron Microscope of New Era

HT7700 transmission electron microscope

The HT7700 is a TEM (transmission electron microscope) with a maximum accelerating voltage of 120 kV that was developed for use in biomedical, nanotechnology, soft materials, and a wide range of other fields.

The adoption of a new design that integrates operations of image-observation subsystem and image-recording subsystem in single man-machine interface has made it possible to achieve superior operability. It uses a real-time screen camera instead of historical fluorescence screen and binocular. This design offers control through simple operations on the monitor screen, and enables observations to be made in a lighted room.

[Key features]

(1) TEM operations have been unified on the monitor, enabling observations in a lighted room.

(2) The adoption of a real-time screen camera makes it possible to observe even lower-electron dose images on the monitor.

(3) Functions for taking and creating combined panoramic image using Hitachi's original algorithms are included standard.

(4) New vacuum system with an efficient turbo-molecular pump provides a clean vacuum while reducing CO_2 (carbon dioxide) emissions by approximately 30% (when compared to existing models).

(5) The HT7700 retains all the fundamental concepts upon which Hitachi 120-kV TEMs are based, namely low-magnification/wide-field observation, high-contrast observation, high-resolution observation, and low-dose observation capabilities.

Hitachi will continue its development efforts in order to offer even more new TEM operational environments in the future.

(Hitachi High-Technologies Corporation)

[Release date: August 2010 (international)]

M-6180 Microwave Plasma Etching System

The M-6180 supports silicon processing of the power semiconductor used for power management, including power supplies, inverters, and other power applications in areas such as digital mobile devices, home appliance products, automobiles, railroads, and industrial equipment. In addition to the high-density plasma of the microwave ECR (electron cyclotron resonance) method, a clean etching environment provides both high precision and mass production capabilities.

[Key features]

(1) Highly uniform silicon processing through the use of high-density plasma

(2) The application of low-temperature etching and TM (time modulation) bias technologies enables the achievement of a highly precise and smooth side wall shape.

(3) Thanks to its clean, low-deposition process, the M-6180 offers both a high level of mass production as well as long chamber wet cleaning cycles.

(Hitachi High-Technologies Corporation)

M-6180 microwave plasma etching system

RS6000 Multipurpose SEM

RS6000 multipurpose SEM

As semiconductor devices have become increasingly miniaturized, the mechanisms that cause defects to occur have grown more and more complex, and the types and numbers of defects that influence yield rates have been on the rise. Dividing this huge number of defects into those originating in the design, those originating in the processing conditions, and those originating in the equipment, while quickly and efficiently extracting valid data, is absolutely imperative when it comes to improving yield rates.

RS6000 provides a solution that lets users rapidly implement countermeasures against defects. This machine offers the following features with the objective of supporting multipurpose usage with a new electronic optical system that dramatically improves existing defect review SEM (scanning electron microscope) functions:

[Key features]

(1) High resolution

(2) High-speed ADR (automatic defect review) function

(3) ADC (automatic defect classification) function

(4) Ultrasensitive testing (fixed point comparison testing) is possible.

(5) A systematic defect classification function (classification based on design data) is supported.

This multipurpose SEM will contribute enormously to the development and production of rapidly evolving next-generation devices.

(Hitachi High-Technologies Corporation)

Development of the Photo Nanoimprinting Machine

Photo nanoimprinting machine

Photo nanoimprinting can be used to form nano-scale structures by pressing a template with fine structures onto a resin layer. It is expected to be applied as a manufacturing method for electronics and other devices. In order to resolve defect generation and low throughput issues during mass-production, Hitachi, Ltd. and Hitachi High-Technologies Corporation developed a high-productivity photo nanoimprinting machine equipped with a flexible template that can decrease the range of defects. A newly developed fast-curing resist material was applied to drastically reduce the cycle time of the nanoimprinting process, and UV-LEDs (ultraviolet light-emitting diodes) are used in the cure-lamp unit, drastically downsizing the system.

An Advanced Batch-processing System in a Multiprocessing-capable Platform "QUIXACE"

The QUIXACE is Hitachi Kokusai Electric Inc.'s latest platform for batch thermal processing of 300-mm wafers. This system offers high throughput, utilizing advanced technologies in areas such as temperature control, wafer handling automation, reactor purging, and temperature ramping. Hitachi Kokusai Electric offers the QUIXACE as the leading platform for today's manufacturing environment, offering both flexibility and extendibility to meet tomorrow's challenges.

[Key features]

(1) Multi-purpose

- Standardized platform design for 1/2 boat systems and ATM/N_2 mode
- Easy modification
- Oxidation, LP-CVD (low-pressure chemical vapor deposition), and annealing

(2) High productivity

- Overhead time reduction
- Fast heater ramp up/down time and high-speed wafer transfer automation

(3) Low-energy operation

- Reduced energy consumption, exhaust, N_2 gas, and water usage

(4) Reliable operation

- Wafer detection system (number and status)
- Smart touch panel (gas pattern and jacket heater)
- Advanced motion control and monitoring system

(Hitachi Kokusai Electric Inc.)

"QUIXACE" advanced batch-processing system

High-speed, High-precision Laser Drilling Machine with High Productivity

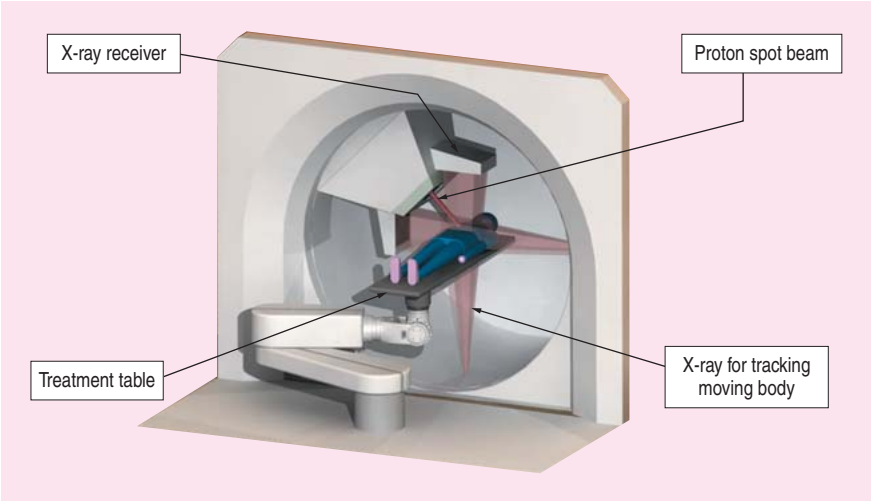
CO_2 laser drilling machine model LC-2L252/2C

As electronic products increase in functionality, PCBs (printed circuit boards) become denser, and the numbers of drilled holes increase, demand is on the rise for greater precision and productivity in the laser processing part of the manufacturing of PCBs. The LC-2L252 is a product developed to meet these needs.

[Key features]
(1) The new high-output H1500 laser oscillator included in this machine offers an output of 250 W (30% higher than previous models), and an oscillation frequency of 10 kHz (twice what was possible in previous models), thereby enabling even higher-speed and higher-quality drilling. In addition, it utilizes Hitachi's proprietary CO_2 (carbon dioxide) gas inclusion method-based slab type design, which eliminates the need for daily maintenance while extending the lifespan of the machine further.
(2) Thanks to the achievement of a high galvanic speed of 3 kHz or higher, the drilling speed has also been greatly increased. During the three-shot processing that is a typical condition for HDI (high-density interconnect) PCBs, productivity is improved to around 150% when combined with the improvement effects offered by the optical system.
(3) At ±12.5 µm, the hole positioning precision of Hitachi's laser drilling machines is already higher than that offered by the rest of the industry. This capability has been improved even further with this model, which has achieved ±10 µm as confirmed by Hitachi's testing. This will allow the LC-2L252/2C to be applied to the manufacturing of next-generation high-density PCBs.
(Hitachi Via Mechanics, Ltd.)

Hokkaido University and Hitachi to Begin Joint Development of an Innovative, World-first Proton Beam Therapy System for Cancer Treatment

Hokkaido University and Hitachi have started the joint development of a new type of PBT (proton beam therapy) system for cancer treatment. This joint development project is being conducted under the Funding Program for World-Leading Innovative R&D on Science and Technology (FIRST Program), a national program sponsored by the Japanese government.
Hokkaido University has developed real-time tracking technology that can irradiate moving tumors by identifying the location of a gold marker inserted in the proximity of a tumor with X-ray fluoroscopic images, in order to irradiate only when the tumor arrives at an anticipated position.
Hitachi has developed and delivered the most sophisticated type of PBT system, the spot scanning technology, to the MD Anderson Cancer Center located in Houston, Texas. This is the first time the technology is being used in the USA.
In this jointly developed real-time tumor-tracking proton beam therapy with molecular imaging technique, Hitachi will develop a compact synchrotron accelerator and gantry PBT system with spot scanning technology that will be combined with Hokkaido University's real-time tumor-tracking technology, in order to deliver the proton beam more precisely to the tumors in organs as they move in synchronization with respiratory movement. The newly developed system will be installed in Hokkaido University Hospital, and patient treatment will begin in 2014 in order to explore a new capability for proton therapy.

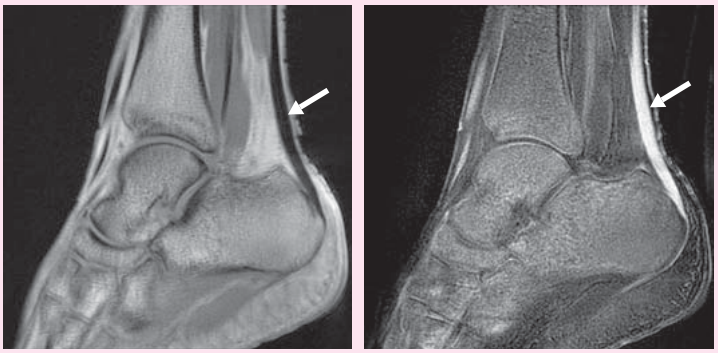


Computer graphic image of a molecular-tracking radiotherapy system treatment room

Advanced MRI Applications Using High Magnetic Fields

MRI (magnetic resonance imaging) devices usually require several minutes to obtain a single image, and false images can be created during this process by a moving subject, or by a beating heart. In addition, in the field of MRA (magnetic resonance angiography), which is used to diagnose narrowed blood vessels and other conditions, non-contrast MRA is attracting attention as a means of avoiding the side effects caused by the contrast medium.

Hitachi's MRI products feature the RADAR (radial acquisition regime) technique, which can inhibit the false images described above, as well as MRA without contrast medium.

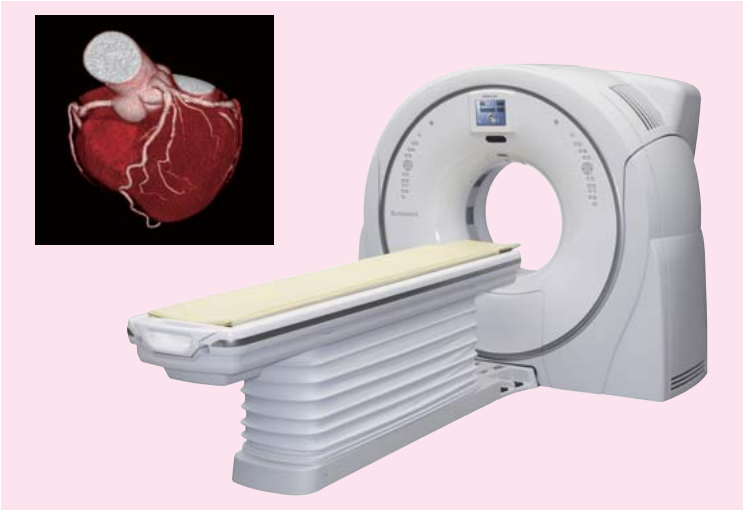


MRI images of an Achilles tendon [comparison between a traditional TE = 4.4-ms image (left) and an image created with a TE = 250-μs μTE sequence (right)]

RADAR can be applied to regions throughout the entire body, and shows particular promise in the use of plaque imaging for evaluating the properties of plaque seen in blood vessel walls in the neck region, including arteriosclerosis (collaborative research conducted with Iwate Medical University). In addition, with the "μTE sequence" and its extremely short TE (echo time), this technology is applied to joint regions to depict cartilage, ligament, and tendons, for which signals could not be achieved previously, at a high level of photographic sensitivity, thereby contributing to the early detection of disorders as well as preventive medicine (collaborative research conducted with Kobe University). The VASC-ASL (veins and arteries sans contrast-arterial spin labeling) method of non-contrast MRA can create images that encode only portal veins, renal arteries, and other bloodstreams without the use of contrast medium, and is very useful in clinical practice (collaborative research conducted with the Kashiwa Hospital of Jikei University).

(Hitachi Medical Corporation)

SCENARIA 64-ch Multislice X-ray CT System



SCENARIA 64-ch multislice X-ray CT and a 3D image showing a heart and coronary arteries (top left)

The SCENARIA 64-ch multislice X-ray CT (computed tomography) system uses a high-speed data acquisition device that can perform a scan in 0.35 s per rotation, making it possible to take images of the entire body, including the heart, the chest region, the abdominal region, etc.

In addition to the world-first* utilization of a 2D (two-dimensional) scattered radiation collimator as the detector in a 64-ch system, this high-performance CT system achieves high-speed imaging, high-quality images, and low exposure, through the use of Hitachi's unique CORE (cone-beam reconstruction) image reconstruction algorithm which provides a high level of image quality, as well as the latest X-ray exposure reduction technology.

One major feature of this system is the ability to combine a horizontal bed sliding mechanism that can move up to a maximum of 80 mm to the left and right with an X-ray compensation filter switch. In the case of heart imaging, a low-exposure X-ray compensation filter is used to throttle the X-rays, and the horizontal sliding mechanism is used to position the heart at the center of the narrowed X-ray imaging view field, thereby reducing exposure. In addition, the gantry aperture has been enlarged and designed with a shallow depth in order to enable the patient to be scanned both comfortably and securely, and the monitor in front of the gantry explains the scanning process and helps the patient practice holding his breath.

This design based on consideration for the patient has been highly praised, earning the system both the Good Design Award 2010 and the 4th Kids Design Award (TEPIA Award).

(Hitachi Medical Corporation)

* As of September 2010, based on investigations conducted by the Hitachi Medical Corporation

Hitachi's Continuous Flow Ultracentrifuge System Contributing to Production of Vaccine for Infection Prevention

This continuous flow ultracentrifuge is mainly used as production equipment to separate and recover large quantities of cultured pathogenic viruses and other useful target materials from a culture solution as part of the manufacturing process of a vaccine that is to be used to prevent the spread of infectious viral diseases. Pathogenic viruses and other useful materials are extremely small particles (on the order of 18 to 300 nm), and the continuous flow ultracentrifuge is vital equipment that provides the ultrafast spinning capabilities necessary for separating, refining, and concentrating these products.

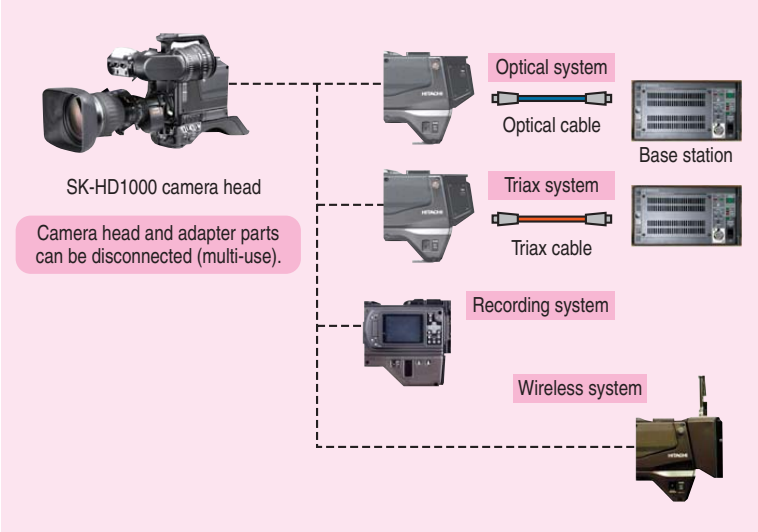
Pharmaceutical and vaccine manufacturers are demanding improved antiseptic characteristics in the separation process, electronic data management of medicinal product manufacturing records, and production equipment with flexible configurations and specifications that can support medicinal product manufacturing equipment in such a way as to improve the quality level of medicinal products while simultaneously improving efficiency.

In order to respond to these demands, Hitachi Koki Co., Ltd. released the CC40NX continuous flow ultracentrifuge in October 2009. Among other features, this machine offers a maximum rotational speed of 40,000/min^{-1}, a specimen flow channel that can be sterilized by steam, and support for the recording of electronic operational data.

(Hitachi Koki Co., Ltd.)

CC40NX continuous flow ultracentrifuge

High-definition Color Camera Lineup for Use in Broadcast and Production



SK-HD1000 multi-use camera system

Along with the start of digital broadcasting, the move towards HD (high definition) in television broadcasting has also been proceeding at a rapid pace in countries around the world, and the demand for HD cameras that can shoot vivid images is also on the rise. The SK-HD1000 series recently completed by Hitachi features cameras based on a new concept of allowing a single camera to be put to multiple uses. Broadcast cameras are usually based on a design whereby the head and controller parts are kept separate and connected with cables. Fiberoptic cables are widely used for this purpose, and doubly insulated coaxial cables referred to as "triax" are also laid at sports facilities and other such locations. This camera is constructed in such a way as to separate the main body of the camera from the adapter part. In addition to an adapter for use with optical cables, Hitachi has also developed a triax adapter based on its own digital transmission system, resulting in a camera that can be used in any field. In addition, wireless transmission functions are required for places where the laying of cables itself is difficult, and recording functions are also necessary for applications such as news coverage. Hitachi also offers a lineup of adapters that support these applications as well, including a wireless adapter and a recording adapter that uses flash memory, thereby realizing a multi-use concept that the competition cannot match. The SK-HD1000 series of cameras was used at the Vancouver Olympics, and has already been adopted for use at broadcast stations in 35 countries around the world.

(Hitachi Kokusai Electric Inc.)