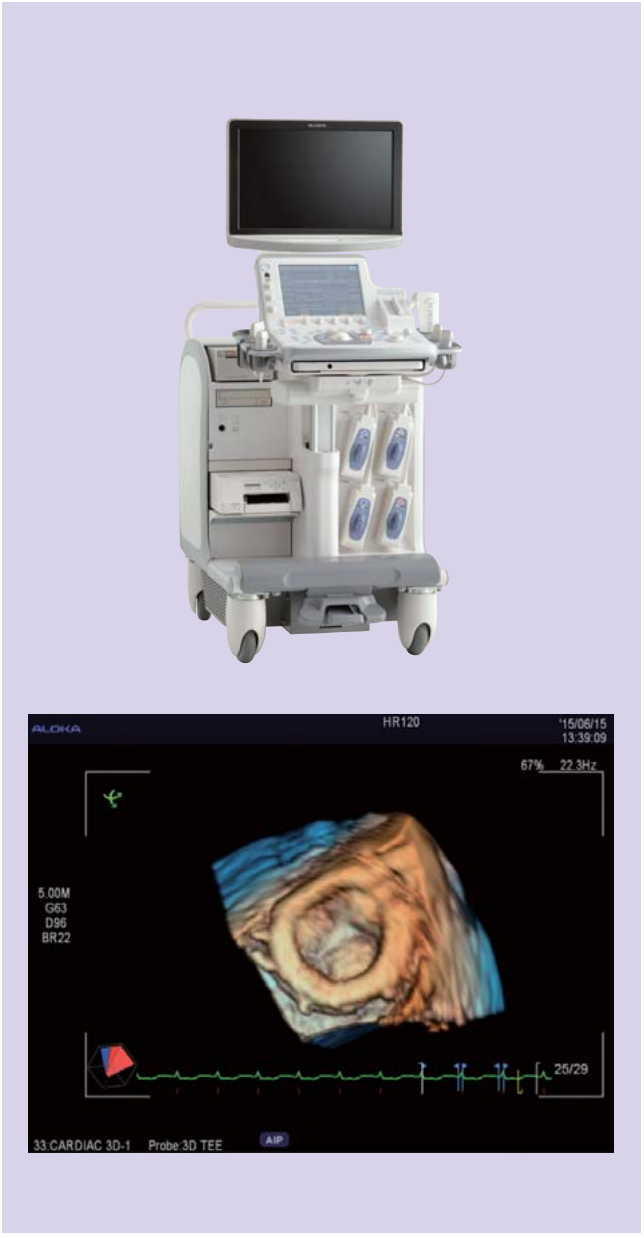
Medical Equipment and Systems



1 Diagnostic ultrasound system (top) and clinical example of artificial valve (bottom)

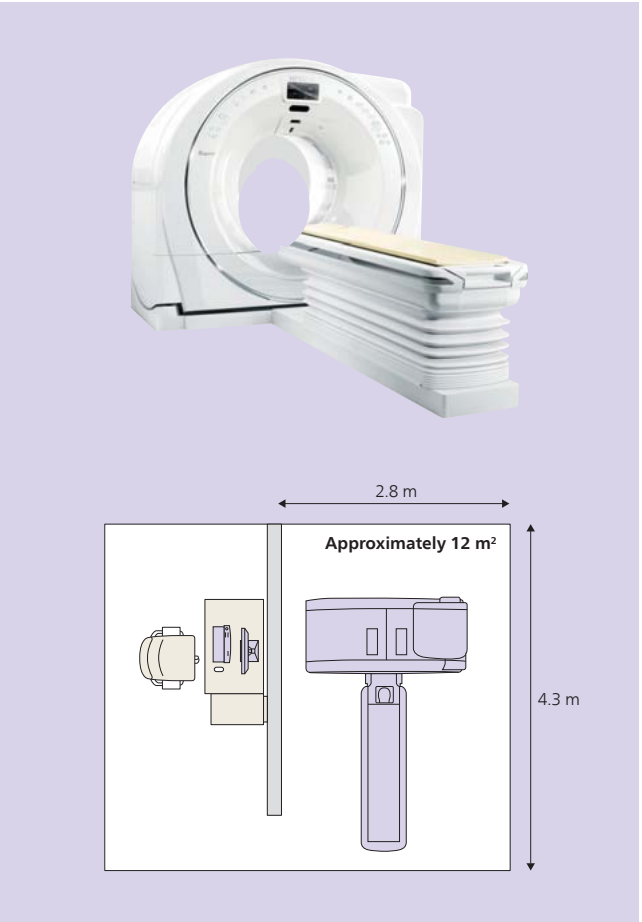
1 Product Development Targeting Circulatory Organs —Diagnostic Ultrasound System and 3D Transesophageal Probe—

The aging of Japan's population has led to rising rates of circulatory organ disease in recent years. In the circulatory disease market, use of three-dimensional (3D) transesophageal probes has been increasing year after year as a way of improving communication between surgeons and physicians before and after surgery. The first such device from a Japanese supplier* designed to be used with a 3D transesophageal probe, a diagnostic ultrasound system, was developed to provide ease-of-use that will enable routine examinations to be performed efficiently, with high quality imaging and an extensive range of functions to suit different circumstances. Along with the light weight of the probe operation unit, even when performing 3D echoes, and the high-quality images and 3D rendering achieved by processing data from a matrix array 3D probe at high speed, it is also capable of a higher level of assessment, with a variety of functions provided for this purpose, such as Active 3D mode for evaluating a particular area of concern.

It helps with early detection and treatment of arteriosclerosis by performing accurate three-dimensional imaging of heart structures, using cardiac function analysis software to assess heart muscle movement, and using the unique functions of the circulatory system to identify changes in blood vessels. It is also suitable for use in a wide variety of examinations, with flexible portability made possible by its natural ergonomics that reduce operator fatigue.

(Hitachi Aloka Medical, Ltd.)

* As of September 2015, based on research by Hitachi Aloka Medical, Ltd.



2 Supria 64-slice CT scanner (top) and example layout (bottom)

2 New Concept 64-slice CT Scanner Supria 64

Most of the computed tomography (CT) scanners currently being installed in regional hospitals are models that capture fewer than 64 slices. The installation of 64-slice or larger models involves a large upfront cost and requires changes to management policies because of strict equipment requirements that include installation space, power supply, and infrastructure, and cost constraints that include running costs that must be funded directly by the hospital. In response, Hitachi has developed the Supria 64, a new concept in 64-slice CT scanners that provides a compact design and high cost-performance along with high speed, a wide field of view, and image quality.

The Supria 64 has a large 75-cm bore that makes things easier for the elderly or patients with severe curvature of the spine and a compact scanner gantry that has been miniaturized to less than 2 m wide and 1.85 m high. The system is made up of three units*, one less than previous 64-slice scanners, to make the best use of available space in even very confined CT rooms. When used in tandem with a standard bed, the system is capable of being installed in a CT room as small as 12 m^2 (approximate area), equivalent to the requirements of a conventional single-slice CT scanner.

(Hitachi Medical Corporation)

* In case the power supply voltage is 200 V.

3 Compact open MRI (top) and example scanner room layout (bottom)

3 Compact Open MRI

The new compact open magnetic resonance imaging (MRI) model features the latest system equipped with a variety of imaging techniques that expand the scope of examination and diagnosis, while still incorporating the same transverse table configuration for ease of operation and use of minimal design to facilitate installation that were features of the previous models.

Positioning the patient in an MRI system is important when imaging shoulders, knees, or other off-center parts of the body in order to perform the scan in the center of the magnetic field where the best image quality is achieved. Unlike many other MRI systems, the table on the compact open MRI model has a transverse configuration as well as a floating mechanism for adjusting the location of the table in the gantry (forward or backward, left or right) that enables centering of the patient when scanning off-center parts of the body.

Compared to MRI systems with a superconductor, the extent of magnetic field leakage from a permanent magnet MRI system is smaller. It also takes up less space because it does not require auxiliary equipment such as routine cooling. This makes it a good choice for replacement installations when it is not practical to enlarge the scanner room or there is a desire to minimize the cost of additional equipment.

Hitachi intends to continue developing distinctive permanent magnet MRI systems using proprietary technology.

(Hitachi Medical Corporation)

4 Optical Topography System

Optical topography systems use near-infrared light to measure the relative concentration of hemoglobin in blood flow through the brain and changes in this concentration. In addition to optical topography, another technique for imaging brain activity from changes in blood flow is functional magnetic resonance imaging (fMRI). However, because fMRI uses an MRI system, scanning takes a long time and can only be performed within the space of the scanner aperture. Optical topography systems, on the other hand, work by attaching near-infrared sensors to the patient's head. This means that scanning can be performed with the patient in a seated position, and it is possible to conduct scans that involve a considerable amount of movement or a patient who is uncomfortable in confined spaces.

Hitachi Medical Corporation first commenced sale of optical topography systems in Japan in April 1998, and the systems are used at numerous overseas institutions in more than 10 different countries, including in North America, Europe, and Asia. The systems are also used in medical practice, and the procedure is approved for health insurance purposes for use in neurosurgery and mental health.

In October 2015, Hitachi commenced sale in Japan of the new ETG-4100 model that incorporates functions that support clinical research as well as improved ease of use in clinical settings in anticipation of the wider medical use of optical topography

4 ETG-4100 optical topography system

scanning.
(Hitachi Medical Corporation)

5 Glycohemoglobin Analyzer cobas c 513

Glycohemoglobin analyzers are used to measure hemoglobin A1c (HbA1c), an indicator of diabetes. HbA1c is glycated hemoglobin (glucose molecules attached to hemoglobin) in the blood and is used for the diagnosis and monitoring of diabetes in terms of the average blood sugar level over a period of one to two months.

The cobas*1 c 513 analyzer improves testing productivity and safety by providing high-speed measurement, automated sample preparation, and a low risk of infection. It was developed in response to the rising demand in recent years for HbA1c testing. The primary market is testing centers or large hospitals in Europe that have a large number of samples to be tested. The cobas c 513 is the fastest special-purpose analyzer in the world*2 to be purpose-designed for HbA1c testing.

The main features are as follows.

(1) High-speed measurement (500 tests/hour, world's fastest*2)

(2) Uses closed-tube sampling (CTS) in which a special probe is inserted into the sealed sample tube to dispense the test samples. By eliminating any need for the operator conducting the analysis to open samples, this minimizes the risk of droplet infection.

(3) Reporting of the HbA1c value complies with international standards specified by the National Glycohemoglobin Standardization Program (NGSP) and International Federation of Clinical Chemistry and Laboratory Medicine (IFCC).

In the future, Hitachi intends to expand sales throughout the world and provide connectivity to sample testing automation systems.

(Hitachi High-Technologies Corporation)
(Product release date: October 2015)

*1 See "Trademarks" on page 140.
*2 For glycohemoglobin analyzers with a CTS function. As of September 2015, based on research by Hitachi High-Technologies Corporation.

5 cobas c 513 glycohemoglobin analyzer

Measurement/Analysis Equipment

1 NX2000 FIB-SEM and FIB-SEM-Ar Triple Beam System

1 FIB-SEM and FIB-SEM-Ar Triple Beam System NX2000

Focused ion beam scanning electron microscope (FIB-SEM) is used for cross-sectional analysis and transmission electron microscope (TEM) sample preparation in various fields such as electronics, nanotechnology, materials, and life sciences. Especially in the analysis of latest shrinking devices and advanced nanomaterials, where uniformly thin high quality TEM samples are required for the analysis of fine structures and the characterization of composition or defects, FIB-SEM plays an important role.

The new NX2000 is designed for the preparation of high-quality TEM sample, combining high-performance FIB optics and high-resolution SEM optics with a micro-sampling system and argon (Ar) beam optics. It features significant improvements to analysis throughput, including site-specific sample preparation and FIB-induced damage reduction, which traditionally required a substantial amount of skill.

NX2000 enables high quality sample preparation without high skill requirements to contribute to the development of the latest devices and advanced nanomaterials.

(Hitachi High-Technologies Corporation)

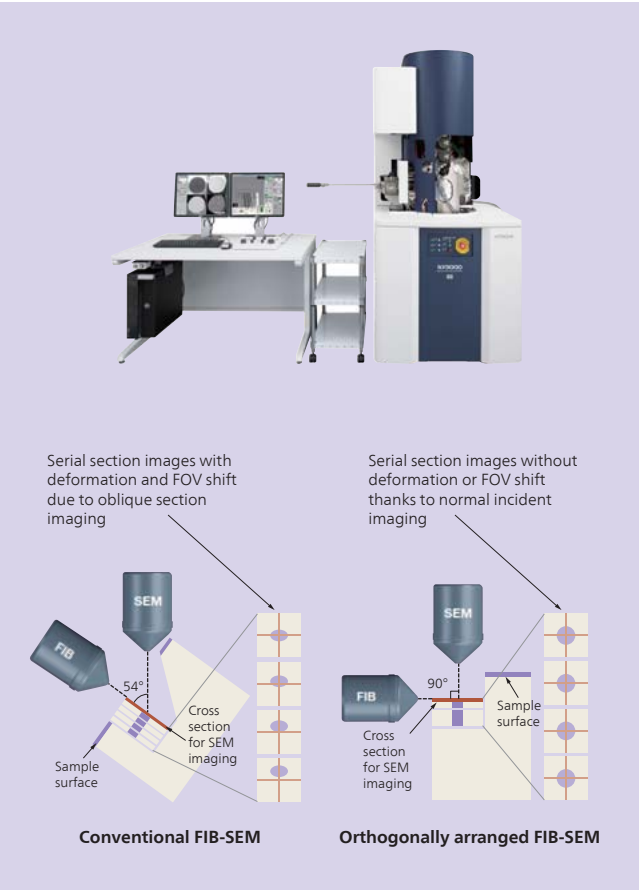
2 Realtime 3D Analytical FIB-SEM NX9000

The evaluation of advanced materials and devices requires the analysis of internal structure as well as SEM observations of surface topography. In recent years, the use of FIB-SEM for three-dimensional (3D) structural analysis has attracted increasing attention. FIB cross-sectioning and cross-sectional SEM imaging are automatically repeated to collect serial section images. Collected images can be reconstructed to analyze the 3D structure of the region of interest.

The newly developed NX9000 realtime 3D analytical FIB-SEM employs a column layout optimized for 3D structural analysis. SEM columns and FIB columns are orthogonally arranged to eliminate aspect deformation, foreshortening of cross sectional images, and shifting of field of view (FOV) during serial section imaging, which cannot be avoided by conventional FIB-SEM, to realize high-fidelity imaging. Also, the combination of precise FIB and a highly stable, high precision sample stage allows highly reproducible serial sectioning even with very small cutting interval. Together with energy dispersive spectrometry (EDS) and electron backscatter diffraction (EBSD), a 3D distribution of elemental composition and crystal orientation can be analyzed.

NX9000 enables high-precision 3D structural analysis, which is difficult with conventional systems, for a wide range of areas relating to advanced materials, electronic devices, biological tissues, and a multitude of other applications to contribute to the development of novel materials and new devices and the elucidation of vital functions.

(Hitachi High-Technologies Corporation)



2 NX9000 realtime 3D analytical FIB-SEM (top) and comparison of conventional FIB-SEM and orthogonally arranged FIB-SEM (bottom)

3 FT-150 series fluorescent X-ray coating thickness gauge

3 Fluorescent X-ray Coating Thickness Gauge

Hitachi has commenced sales of the FT150 series fluorescent X-ray coating thickness gauge for the advanced measurement of plating thicknesses on the very small electronic components used in smartphones and other mobile devices.

The target application for the FT150 is the measurement of plating of 10 nm or less that cover an area of less than 50-µm square. To achieve this, Hitachi has succeeded in doubling the detection sensitivity for fluorescent X-rays from the specimen compared to the previous model, while retaining the same 30-µm irradiation spot size.

The system is designed for routine use at production facilities, including both its software and hardware, with consideration given in all areas to ensure easy operation at every step, from inserting the specimen to positioning it for measurement, performing the measurement, and processing the results.

Hitachi intends to proceed with development along the two axes of technology and design. On one axis, it will proceed with development of technologies for advanced measurement. On the other axis, it will forge ahead in creating easy-to-use product designs that take account of customer feedback. Through this dual-axis approach, Hitachi will supply leading-edge coating thickness gauges for the cutting edge of plating technology.
(Hitachi High-Tech Science Corporation)

4 Coherence Scanning Interferometer VS1000 Series

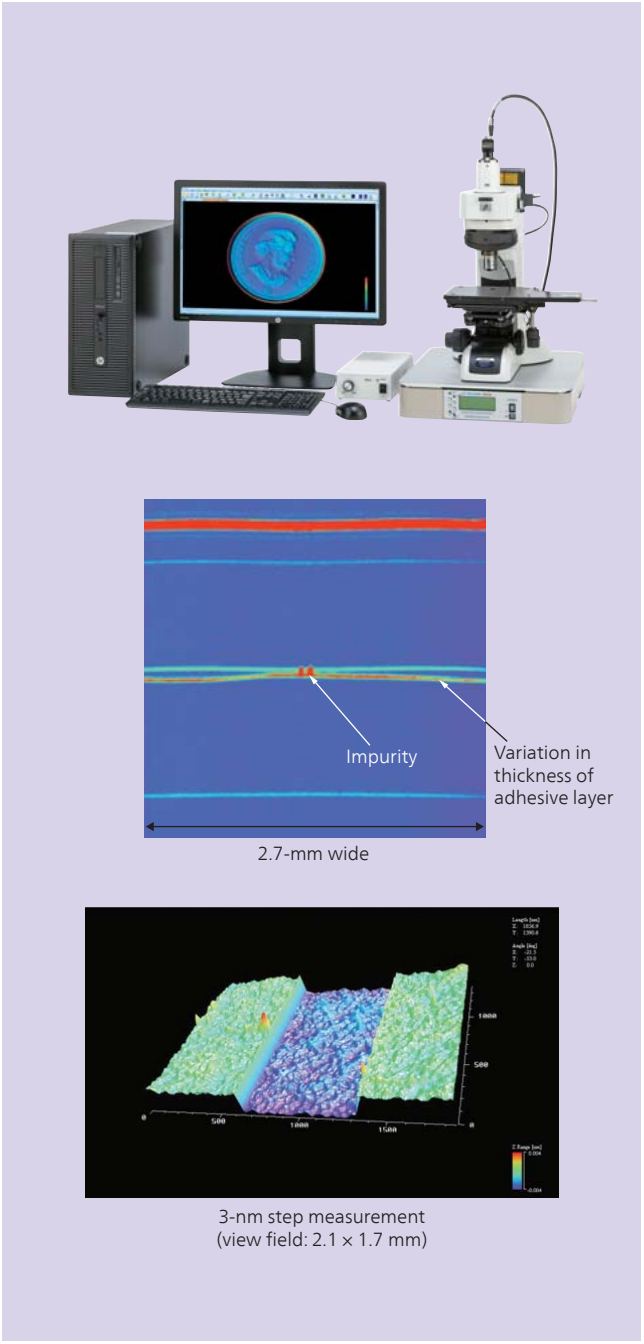
In the development, manufacture, and quality assurance of electronic components, advanced materials, precision-machined parts, and so on, there has been demand in recent years for measurement of micro roughness or features with sizes in the range of several nanometers to several tens of nanometers.

The newly introduced VS1000 series coherence scanning interferometer is a surface inspection instrument for the three-dimensional non-contact and non-destructive measurement of micro roughness, features, and film thicknesses.

The main features are as follows.
(1) Non-contact three-dimensional (surface and height) measurement of micro roughness and other features in a short amount of time (from several seconds to around 10 seconds) and 0.01-nm vertical resolution (Sq resolution) using optical interference measurement that combines a wide measurement field and high Z-axis resolution.
(2) It supports the extension of evaluation procedures from lines to surfaces by providing surface roughness measurements that comply with the ISO 25178 standard for surface texture.
(3) It identifies things like impurities or peeling at the boundaries between layers by measuring the thickness of transparent multi-layer films.

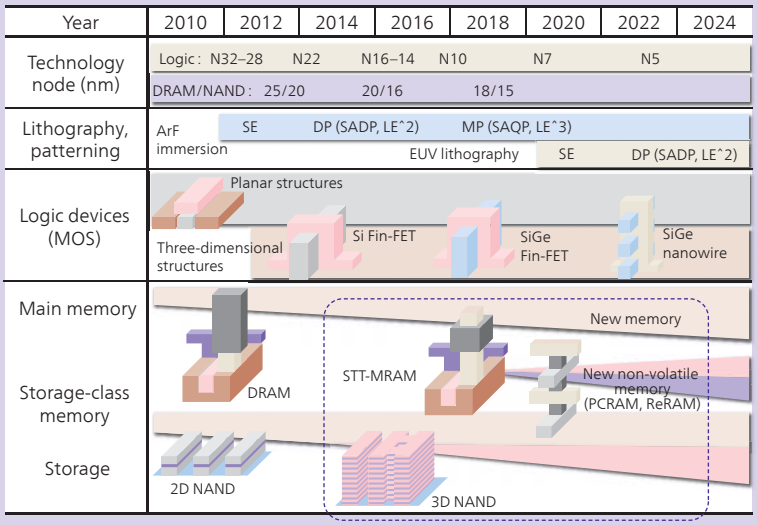
By adding this new coherence scanning interferometer to the other surface inspection instruments marketed by Hitachi High-Tech Science Corporation [scanning probe microscopes (SPMs) and SEMs], Hitachi intends to continue supplying surface inspection solutions that take advantage of synergies.
(Hitachi High-Tech Science Corporation)

* VS1000 series is only sold in Japan.



4 VS1000 series coherence scanning interferometer (compact model) (top), cross-sectional analysis of polarizing film (center), and measurement image of 3-nm step (bottom)

Semiconductor Manufacturing and Inspection Equipment



MOS: metal on silicon, DRAM: dynamic random access memory, NAND: not AND, Ar: argon, F: fluorine, Si: silicon, Ge: germanium, SE: single exposure, DP: double patterning, MP: multi-patterning, SADP: self align double patterning, SAQP: self align quadro patterning, LE: litho etch, STT: spin transfer torque, PCRAM: phase change random access memory

1 Developments in the field of advanced devices

1 New Developments in Advanced Devices and Increasingly Diverse Customer Requirements

Advances intended to improve the performance of the semiconductor devices that underpin the widespread use of products such as smartphones, tablets, and cloud computing servers are being made on a variety of different fronts, including not only miniaturization but also the adoption of three-dimensional structures and new types of memory. In the case of miniaturization, development is progressing on 10-nm nodes and smaller using techniques such as multi-patterning and extreme ultraviolet (EUV) lithography. In the case of three-dimensional structures, vertical stacking of a number of memory transistors and the use of fin-shaped field effect transistors (Fin-FETs) in logic devices and processors have both become mainstream practice. Meanwhile, various companies are developing new types of memory such as magnetoresistive random access memory (MRAM) and resistive random access memory (ReRAM).

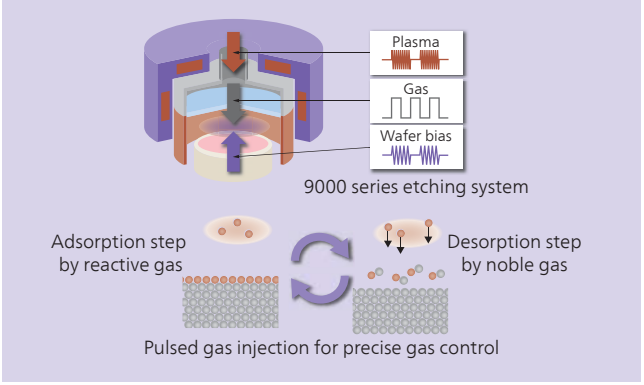
Customer requirements are also changing in response to these developments. In addition to the precision fabrication and measurement of nano-scale patterns, these increasingly diverse demands include process module techniques that improve transistor reliability, measurement techniques that quantify fabrication execution, techniques for the fabrication and measurement of three-dimensional structures such as deep trenches or holes, and support for new materials.

In the future, Hitachi intends to continue supplying technology and other solutions that satisfy these diverse customer requirements.

(Hitachi High-Technologies Corporation)

2 Atomic-level Etching Control Technology Tri Time-Modulation

Along with miniaturization, devices with three-dimensional structures are becoming the norm for semiconductor generations with minimum dimensions of 10 nm or less. Hitachi has been a leader in the use of microwave electron cyclotron resonance (ECR) plasma etchers for microfabrication in the manufacture of semiconductors, and three-dimensional fabrication for these sub-10-nm generations demands control of variation to the level of individual atoms or molecules and ultra-high selectivity to prevent the formation of a damaged layer on the device surface during etching.



2 Tri time-modulation system

Tri time-modulation is a plasma etching control technology with atomic-level precision that can meet these requirements. The dual time-modulation technology used in the past precisely controls plasma densities and ion energies. The new technology augments this with the ability to precisely control gases using pulsed injection of the reactive gases used for etching. Furthermore, by optimizing each of these processes, the technology enables microfabrication with atomic-level precision in a way that works with three-dimensional structures.

This technology is being incorporated into Hitachi's flagship 9000 series and can be retrofitted into systems that have already been delivered. As a result, it is expected to play an active role as a production solution that supports the next generation of device manufacturing.

(Hitachi High-Technologies Corporation)

3 CG6300 High-resolution FEB Measurement SEM

Focused electron beam (FEB) measurement scanning electron microscopes (SEM) are used to measure the dimensions of circuits fabricated using semiconductor manufacturing processes. Hitachi's products have provided behind-the-scenes support for the semiconductor industry, advancing in step with increasing semiconductor miniaturization since the first model was launched in 1984. A total of 4,600 units have been shipped to date. The new CG6300 is designed for use in mass production of the 10-nm generation of semiconductors and beyond, featuring updated electron optics, control, and mechanical mechanisms for improved resolution and dimension measurement repeatability.

The main features of the CG6300 are as follows.

(1) In addition to the existing imaging of pattern formation using secondary electrons, the CG6300 can also perform imaging of material structure using backscattered electrons.

(2) Less noise results in clearer edges. Noise is reduced by doubling the electron beam scanning rate compared to previous models to minimize the effect of residual charge on the wafer surface.

(3) Can process at least 20% more wafers per hour than previous models thanks to a new stage design.

3 CG6300 high-resolution FEB measurement SEM

(4) Long-term reliability with inter-device variation minimized to facilitate use at large semiconductor fabrication plants.

(Hitachi High-Technologies Corporation)

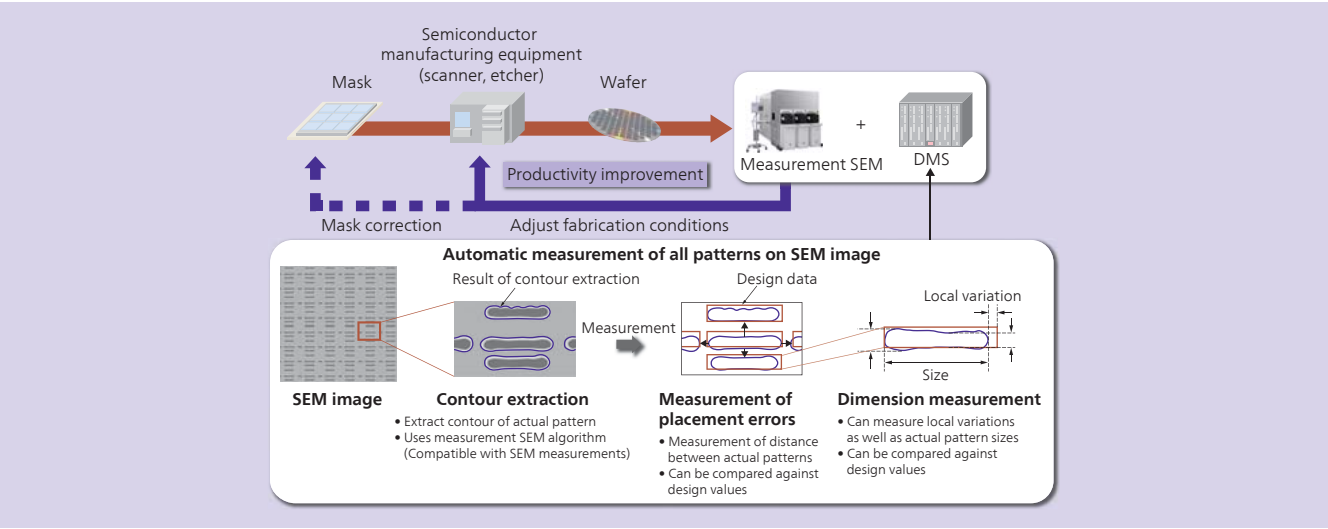
4 Two-dimensional Measurement Solution for Semiconductor Patterns that Helps Increase Yield

As semiconductor devices become increasingly miniaturized, it becomes more difficult to determine the best production conditions for forming the pattern in accordance with the design. Achieving a faster startup of high volume manufacturing and cutting labor costs require fully automated measurement procedures that are precise enough to perform quantitative evaluations of how well patterns have been formed under volume manufacturing conditions and to provide feedback to the fabrication process.

A defect metrology system (DMS) is solution for improving yield that performs precise two-dimensional measurements based on contour extraction, a core technology of Hitachi High-Technologies Corporation. It uses 24 different measurements to make a quantitative evaluation of how well fabrication has been performed, including placement errors, and fully automatic measurement of all pattern dimensions on the SEM image.

In the future, Hitachi intends to improve the performance of the solution and expand its use to include defect inspection as well as measurement.

(Hitachi High-Technologies Corporation)



4 Overview of DMS

Electronic Equipment and Power Tools

1 SK-UHD8060B UHD-2 broadcast camera in recorder configuration (top), with the optical transmission unit and UHD-1 view finder (bottom)

1 UHD-2 Camera System for Next Generation of Broadcasting

The broadcasting market is starting to take major steps toward the implementation of the upcoming UHD-1 and UHD-2 generations. Hitachi's new UHD-2 broadcast camera (SK-UHD8060B) was jointly developed with the Japan Broadcasting Corporation. This groundbreaking broadcast camera system is suitable for a wide variety of different uses. Along with the development of a built-in recording unit, the camera and optical transmission unit have been made smaller to facilitate the production and transmission of UHD-2 video.

The main features of the SK-UHD8060B are as follows.

(1) The ways in which the system can be used have been significantly improved, with a dockable design that enables the camera head and optical transmission unit or camera head and recording unit to be combined.

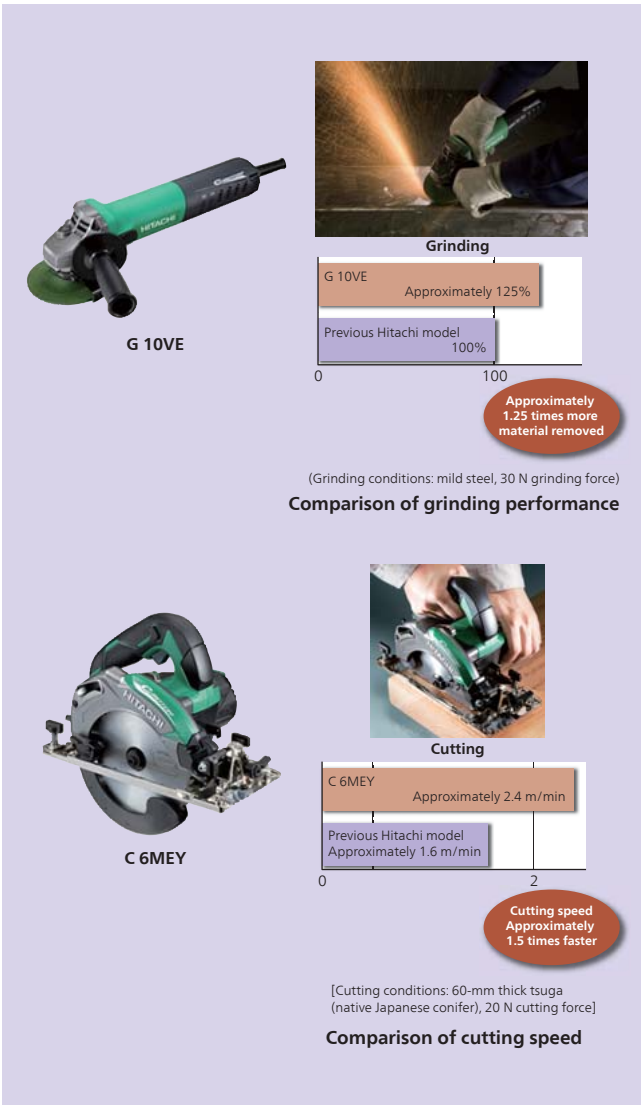
(2) UHD-2 video recording has been significantly enhanced by the recording unit, which can record 40 minutes of video on a solid state drive (SSD) slot with 2-Tbyte capacity.

(3) Can operate as a system camera by connecting the optical transmission unit. A range of peripherals are available, including a UHD-1 view finder, and the system can be fitted with a large lens and used as a studio camera.

(Hitachi Kokusai Electric Inc.)

2 Power Tools with Brushless AC Motors G10/13VE, G10/13YE2, G15YE2, C6MEY/UEY

While the past requirements for power tools have been for their underlying performance, namely high work efficiency, small size, and light weight, new functions that make the tools more convenient for users have also become important in recent years. In response, by using proprietary technology to drastically shrink the size of the inverter circuits, Hitachi has developed products that incorporate new functions as well as being designed for high



2 Power tools with brushless AC motors

work efficiency, small size, and light weight by using highly efficient brushless alternating current (AC) motors in disk grinders and circular saws, an industry-first for hand tools[*1, *2].

The main features of the power tools are as follows.

(1) Class-leading work efficiency[*1,*2] [G10VE: 1.25 times higher grinding capacity (material removal) than previous model, C6MEY: 1.5 times faster cutting speed than previous model]

(2) Smallest and lightest in class[*1,*2], and well balanced for excellent maneuverability to reduce user fatigue

(3) A kickback minimization system that works by monitoring for changes in the motor speed and momentarily stopping the motor whenever a sudden deceleration occurs

(4) A function for preventing the power tool from starting unintentionally avoids accidents by preventing the tool from starting when the power is plugged in with the switch in the ON position.

(5) A small, highly efficient inverter developed by Hitachi enables the tools to be used with engine generators

(6) Monitoring of the power supply and load ensures reliable operation when using an extension cord, despite the associated voltage drop

(Hitachi Koki Co., Ltd.)

*1 Among Japanese power tool manufacturers. As of May 2015. Based on research by Hitachi Koki Co., Ltd. (100/125/150-mm class electronic disk grinders)

*2 Among Japanese power tool manufacturers. As of April 2015. Based on research by Hitachi Koki Co., Ltd. (deep-cut electronic circular saws with 165-mm blades)

3 Cordless Impact Drivers WH14DDL2 and WH18DDL2

Cordless impact drivers can be used for different tasks such as tightening screws, tightening bolts, and drilling holes by changing the tool bit. Their primary use, however, is for fastening building materials in timber home construction. While there has been a notable increase in characteristics like torque and screw tightening speed in recent years for use with hard materials such as laminated timber or with long screws, these changes have brought with them an increase in problems such as the screwdriver bit slipping off the screw head or the oversinking of short screws. The new models have been made easier to use by using a triple-hammer mechanism (three hammer claws compared to two on previous models) that reduces problems like slipping out or oversinking by increasing the number of small-force impacts (three impacts per rotation). In contrast, power mode (1.5 impacts per rotation) increases the hammer impact energy to provide faster screw tightening. This is achieved in tandem with Hitachi's proprietary active control system (ACS) function for optimal control of the motor speed, impact timing, and other parameters, providing ease of use and higher performance in the same tool.

The main features of the cordless impact drivers are as follows.

(1) New industry-first* triple-hammer impact mechanism delivers both ease of use (fewer problems with screwdriver bit slipping off screw head or oversinking) and higher performance (leading screwing speed and tightening torque than previous models).

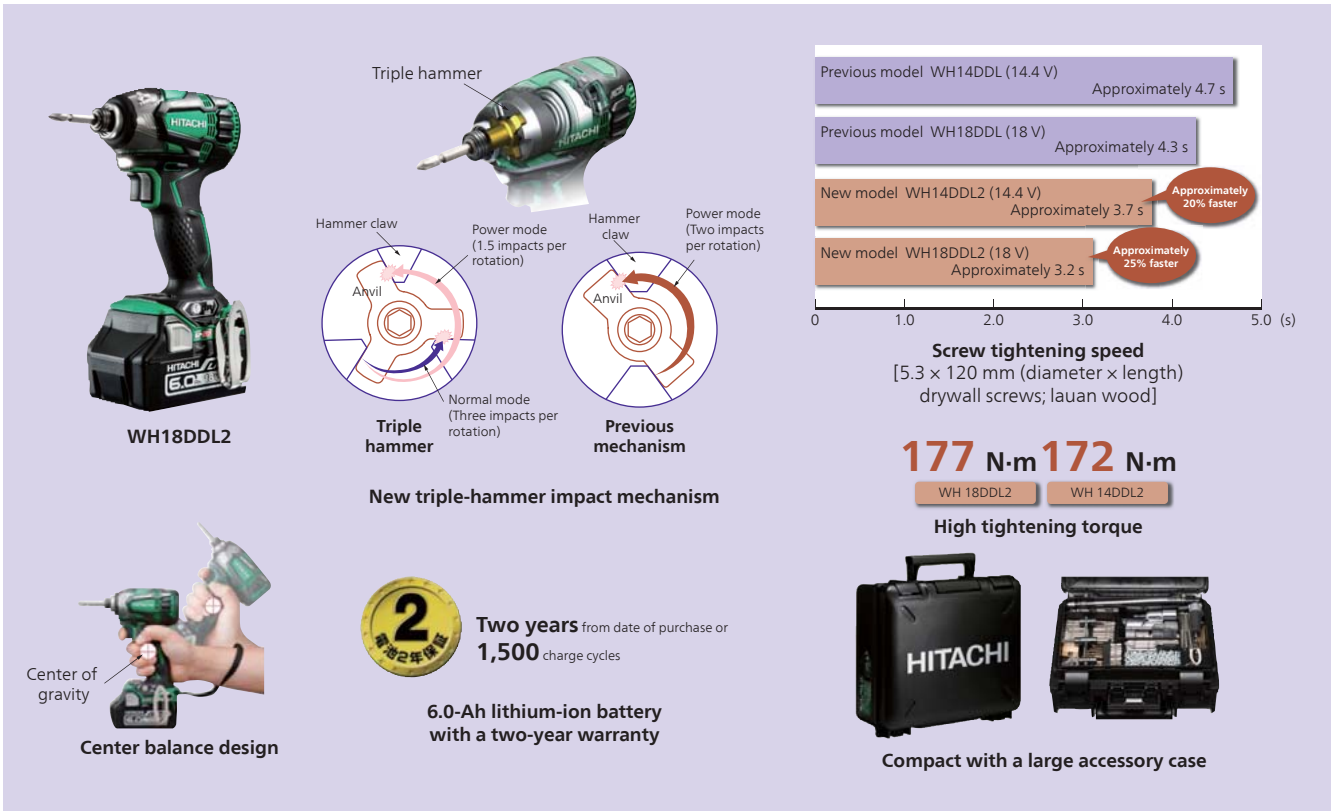
(2) Center balance design reduces user fatigue.

(3) Supplied with a 6.0-Ah lithium-ion battery with a two-year warranty (delivers approximately 1.2 times more work than a 5.0-Ah battery).

(4) Compact case with a large accessory holder

(Hitachi Koki Co., Ltd.)

* Among Japanese power tool manufacturers. As of July 2015, based on research by Hitachi Koki Co., Ltd.



3 Features of cordless impact drivers