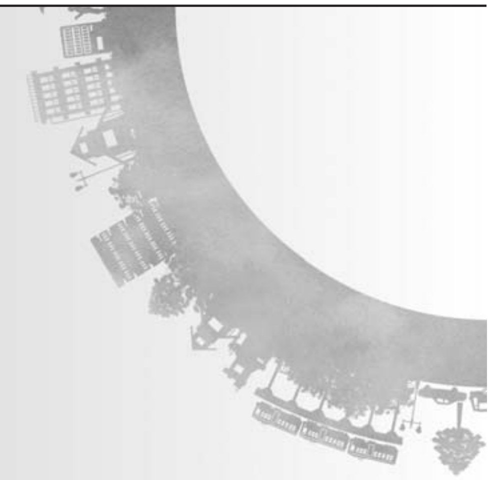
Fundamental and Advanced Technologies



Design and Manufacturing Support Technologies
Materials Technology
Incubation Technology

Outlook

In July 2012, Fuji Electric adopted a new brand statement, “Innovating Energy Technology,” which reflects its ongoing “pursuit of innovation in electric and thermal energy technology in order to create products that maximize the efficient utilization of energy and to contribute to the creation of responsible and sustainable societies.” Underpinning the realization of this goal is design and manufacturing support technology. Design and manufacturing support technology is being developed in close cooperation with the departments that actually develop products.

Fuji Electric has newly developed a spectroscopic analysis method based on radiated light and infrared light, and with the addition of various types of microscopic analysis has established comprehensive techniques for analyzing gate oxide interfaces, crystal defects and the like. These techniques have been used in such applications as the development of SiC (silicon carbide) devices, which are currently the focus of attention as next-generation semiconductor devices, and are making positive contributions. Additionally, Fuji Electric aims to increase the efficiency of materials development through using molecular dynamics calculations and first-principle calculations to develop materials design technology for designing resin material structures and additives used in semiconductor interface structures and semiconductor packages. To increase the reliability of semiconductor devices, Fuji Electric has developed micro strain distribution measurement and evaluation technology for the contacts in semiconductor packages. In addition, so that these advances can be applied to improve insulation in semiconductor modules and to increase the breakdown voltage, Fuji Electric has established technology for visualizing partial discharge inside a module, and has clarified the mechanism by which partial discharges are generated.

For the purpose of deploying power electronics products in the global market, Fuji Electric has developed a virtual test environment that can be used directly with actual product programs. This virtual test environment enables the development and verification of customized products according to customer needs at overseas sites and the like that lack verification equipment. Additionally, Fuji Electric has developed magnetic field analysis technology for high-frequency transformers, which are a key component in high-frequency insulated-type transformers, the use of which is being advanced to realize the objectives of miniaturization and lighter weight, and this technology is being utilized to improve performance, and to shorten the development and design cycles. With the growing demand for earthquake resistance, Fuji Electric has developed an earthquake-resistant-housing design tool for distribution boards, and has established design technology for safe and secure electric equipment in response to various requests for earthquake resistance. Especially in the power electronics field, compliance with international standards has become increasingly important, and Fuji Electric has strengthened its compliance by establishing an in-house international standardization committee. Externally, Fuji Electric is actively involved in the assessment of standards for electromagnetic compatibility (EMC: the generation or reception of electrical or magnetic interference) and efficiency measurements.

As materials technology unrelated to electronic and thermal energy, Fuji Electric is advancing the development of high density magnetic recording media materials and photoconductive materials. As magnetic recording media for hard disk drives, for which larger capacities are continuously sought, Fuji Electric has optimized the organization and microstructure of each recording layer, and has commercialized 3.5-inch aluminum disk media having a storage capacity of 1 TB per disk, and 2.5-inch glass disk media having a storage capacity of 500 GB per disk. For photoconductors, demands are increasing for lower price, longer life and higher performance. Fuji Electric has responded to such requests by developing functional materials capable of reducing costs by 15% or more while realizing the same level of performance as before, and resin materials that enhance wear resistance by 20% or more, and has applied these materials to new products.

As incubated technologies, mostly various measurement technologies have been developed. Battery-free wireless sensing technology for measuring temperature and humidity has been developed, and application to a wide range of fields, such as data centers, showcases and the like is anticipated. Additionally, laser-based multi-composition multi-analysis technology capable of analyzing aerosols, for which the impact on health is a concern, has been developed. Furthermore, Fuji Electric is applying micro electro mechanical systems (MEMS) technology to advance the development of optical scanners for controlling the direction of laser light, a promising medical device application and the development of miniaturization and black-boxing of signal processing units for sensors.

Fuji Electric will continue to strive to research and develop advanced technology that leads to innovative electric and thermal energy technology and measurement and control technology.

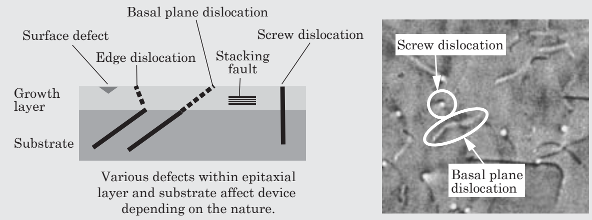
Design and Manufacturing Support Technologies

1 Analysis Technology Supporting Development of Next-Generation Power Device

Development of silicon carbide metal-oxide-semiconductor field-effect transistor (SiC-MOSFET) and silicon carbide insulated gate bipolar transistor (SiC-IGBT) as a high-voltage and low-loss power device is underway. Control of atomic defects of gate oxide interfaces, substrates and epitaxial layers is a common material issue with these devices.

Fuji Electric specifies the type of defects and position on substrate and epitaxial layer by topography analysis in addition to spectroscopic analysis with synchrotron radiation and infrared radiation, and nanoscopic analysis with a transmission electron microscope. There are various types of defects that can occur on an SiC substrate ranging from a large-scale plane defect to an ultra-microscopic dislocation (basal plane dislocation and screw dislocation). X-rays are irradiated on these defects and the structural abnormality at the atomic level is clarified from the difference in diffracted light. By using this technology, the influence that each defect has on the device is clarified and a more reliable SiC power device is realized.

Fig.1 Topography of defect by synchrotron radiation

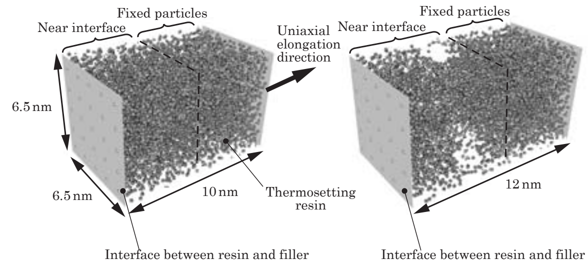


(a) Various defect factors (b) Topography of defect determined by synchrotron radiation

2 Analysis Technology of Material Properties Based on Molecular Simulation

In order to obtain a guideline which satisfies the material properties of resins that are necessary for improvement of products, analysis technology by using molecular simulation is being developed from the viewpoint of molecular structure and electronic state. Currently, Fuji Electric aims to obtain a heat-resistant resin available at a high temperature and is analyzing the behavior of a nanocomposite resin consists a of thermosetting resin and inorganic filler, whose material properties depend on the filler. It was revealed that the glass transition temperature of the resin adjacent to the filler was increased as cross linking reaction progresses by using molecular dynamics calculation. Furthermore, the result from the calculation of the uniaxial elongation near the interface shown in the right figure suggested that the modulus of elasticity near the interface was greater than that of the bulk resin. In the future, through the study on analyzing the oxidization of resin and adhesion of resin to an inorganic material, Fuji Electric will contribute to bring well-balanced resins in material properties.

Fig.2 Uniaxial elongation model of an interface between thermosetting resin and filler



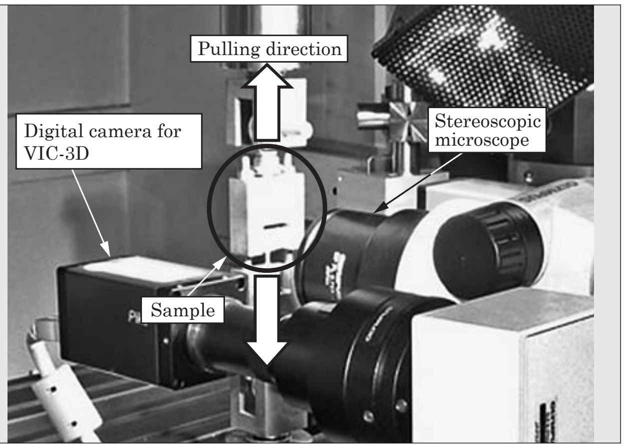
(a) Before uniaxial elongation (b) After uniaxial elongation

3 Technology for Evaluating Micro Part Skew Distribution to Improve Reliability of Device Design

Reliable device designs in areas such as the junction between the chip and substrate are drawn up mainly by stress analysis using the finite element method. In order to determine the behavior when deterioration such as cracks occurs, it is necessary to know data such as the skew distribution of minute joints and stress intensity factor. For this reason, Fuji Electric has developed skew distribution technology for minute sections.

By surface treatment that provides a luminance difference at the target section and by processing stereoscopic microscope images with the digital image correlation method, Fuji Electric has developed skew distribution evaluation technology with 10 times of the resolution and accuracy comparing the existing technology. Furthermore, from the result of this measurement, it was enabled to calculate the stress intensity factor of the tip of a crack directly. Consequently, the error of stress analysis was reduced by one-fifth compared to before and more reliable device designs became possible. In the future, this technology will apply to ensure reliable designs of new products.

Fig.3 Structure of evaluation device

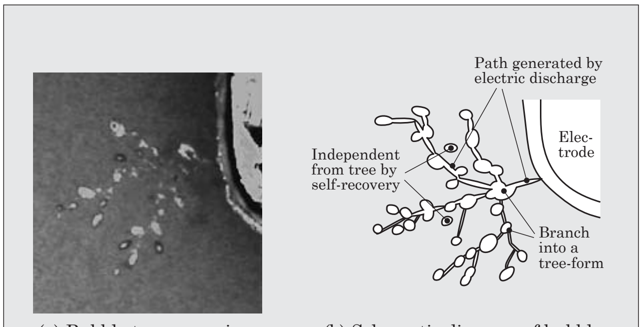


4 Partial Discharge Visualization Technology for Power Semiconductor Module

A higher withstanding voltage is required to achieve high-efficiency power electronic equipment used in wind power generation facilities, electric railroads and mega solar systems. For power semiconductor modules, an issue to overcome is how to improve the insulation performance at the interface between a silicone gel used as mold resin, and ceramic substrate.

Fuji Electric has developed partial discharge visualization technology to monitor a micro area at high speed by means of combining a high-speed camera and microscope. Bubbles are generated by partial discharge at the interface and a bubble tree is formed as the bubbles move. This phenomenon was observed and the discharge occurrence mechanism at the interface, which used to be unknown, was clarified. In the future, Fuji Electric will improve the insulation performance of the interface and contribute to the development of power semiconductor modules.

Fig.4 Bubble tree occurring at interface between silicone gel and ceramic substrate



(a) Bubble tree occurring at the interface

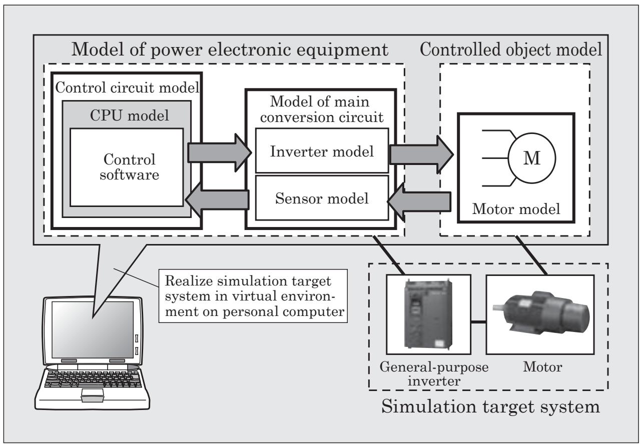
(b) Schematic diagram of bubble tree development on gel and substrate interface

5 Virtual Test Environment for Power Electronics

Fuji Electric has developed a virtual test environment for power electronic equipment in order to enhance its competitiveness in the global market. It is possible to develop and verify customized products according to the customer requirements at overseas bases where there is no verification equipment, and promptly provide products that customers are satisfied.

In the virtual test environment, in addition to main conversion circuits and control circuits for the main body of the equipment, controlled objects such as a load were constructed in virtual environment on a personal computer, and a verification environment without using an actual machine was built. In addition, a simulator that simulates directly a CPU applies to the control circuit model, and this links to an electric and physical system simulator. As a result, a program of the actual products can apply to the control software that becomes the core of the control, which enables to perform verification more promptly.

Fig.5 Configuration of virtual test environment



6 Chassis Earthquake-Resistant Design Technology for Switchboards

Fuji Electric has complied with standards such as those of The Japan Electrical Manufacturers' Association (JEMA) and The Japan Electric Association (JEA) and has been implementing earthquake-resistant designs for chassis of switchboards by using the standard seismic intensity with the local seismic coefficient method. Since the Great East Japan Earthquake in 2011, further detailed earthquake-resistant designs have become necessary. There used to be such issues with previous earthquake-resistant designs that the center of the board is uniformly regarded as the center of gravity, and off-position of gravity toward the depth direction of switchboard is not considered.

For this reason, Fuji Electric developed a tool to determine earthquake-resistant designs with which structure, load and gravity can be set arbitrary by dividing internal equipment into several units. As the result of this development, it has become possible to draw up earthquake-resistant designs by complying with "Guideline for earthquake-resistant design and construction of building equipment" (The Building Center of Japan) with improved accuracy and in a short period. In the future, Fuji Electric will rapidly respond to each type of requirement for earthquake resistance and contribute to the installation of safer and more secure electrical equipment.

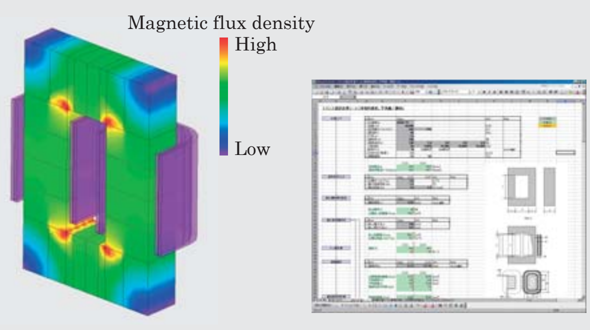
Fig.6 Example of switchboard employed an earthquake-resistant design

7 Magnetic Field Analysis Technology of High-Frequency, High-Voltage Transformer

Recently, high-frequency isolated converters have been widely adopted to reduce the size and weight of isolated type power electronic equipment. Fuji Electric has developed magnetic field analysis technology for high-frequency, high-voltage transformer, which is a core part of such equipment.

This technology is equipped with a circuit coupled and heat coupled analysis function considering the actual working status of the power electronic equipment. For material properties used for the transformer, Fuji Electric's original database, which has been accumulated over many years, is used. In addition, a design calculation tool was developed to calculate various design elements of transformers by using magnetic field analysis and to pursue limit design. With this tool, it is possible to predict performance more accurately in the design of high-frequency, high-voltage transformer. This is used to shorten the development and design period and to improve performance and quality further.

Fig.7 Example of magnetic field analysis for high-frequency, high-voltage transformer



(a) Magnetic flux distribution analysis of transformer core

(b) Design calculation tool

8 Corresponding to International Standards

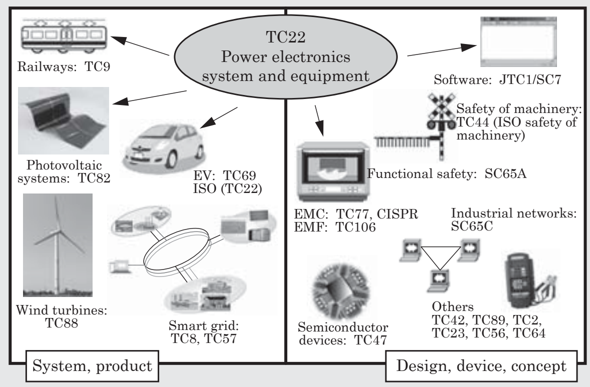
Fuji Electric is carrying out activities to propel its main product power electronics devices as a member of TC22 (power electronics systems and equipment), SC22G (drive) and CISPR (EMC) in the technical committees of the International Electrotechnical Commission (IEC) and conducting technical development to correspond to standards. While developing efforts with the in-house committee in order to carry out activities smoothly, Fuji Electric is contributing to the industry. The main development items are shown below:

(1) Participated in the measurement campaign of the drive EMC specification and indicated the validity of the limit value.

(2) For drive efficiency specification, while considering the characteristics of measuring instruments, established an appropriate method to measure efficiency.

(3) Established an EMC measurement method for high-capacity solar light power converters and offered various arguments for amendment in an international discussion

Fig.8 International standards related to power electronics



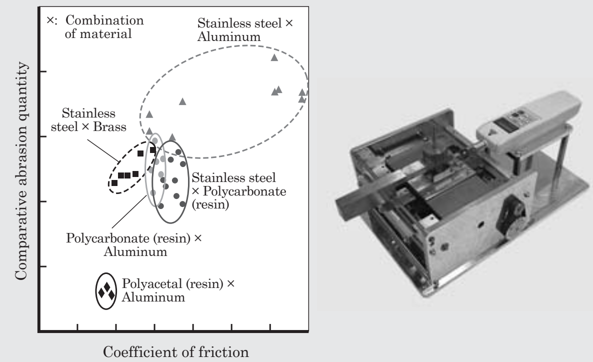
9 Improved Reliability of Machine Design by Tribology

Friction and abrasion on the contact section must be reduced to improve the reliability of product groups with rotating machines and sliding portions such as rotational machine. To meet this end, it is necessary to enhance design technology related to tribology (friction, abrasion and lubrication).

Fuji Electric has obtained the wear map of resin and each type of metal in the case of dry friction (without lubricant) and derived empirical formula to determine the correlation between the coefficient of friction and abrasion loss by using surface roughness, surface energy, material strength, and material hardness.

By applying this empirical formula, the reliability of product groups with sliding portions can be improved. Furthermore, Fuji Electric strives to expand the technology scope to fluid friction (with lubricant) and enhance design technology.

Fig.9 Wear Map and friction/wear test equipment



(a) Wear map

(b) Friction and wear test equipment

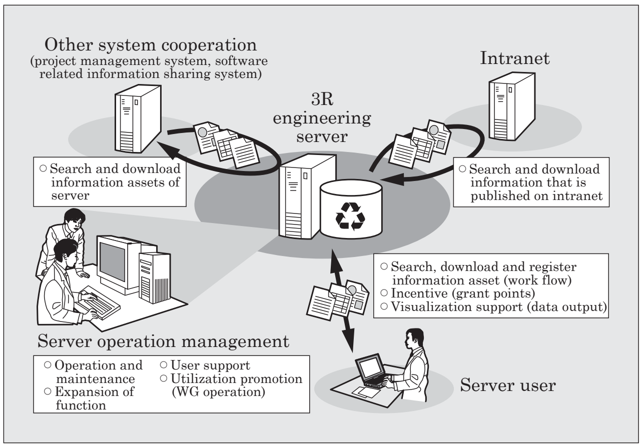
Design and Manufacturing Support Technologies

10 Construction and Operation of 3R Engineering Server

As one of the measures to improve business, Fuji Electric is working on productivity improvement centering on “reuse” of information assets. A 3R engineering server is a system with which all employees register and utilize information assets accumulated in-house such as knowledge, technology and know-how, and this system began operating in May 2010. Employees use an advanced search engine to search information assets registered in the server or information which are published on the intranet, and they are able to utilize these assets for the business.

In 2012, an “Incentive function” to promote utilization and a “Visualization support function” to enable users to browse the utilization state of individuals and divisions and a list of registered assets were developed and provided to the users. Fuji Electric continues to reflect the opinions and requests of users in the system and develop activities for system improvement toward a more user-friendly system and utilization promotion.

Fig.10 Service and operation management that 3R engineering server provides

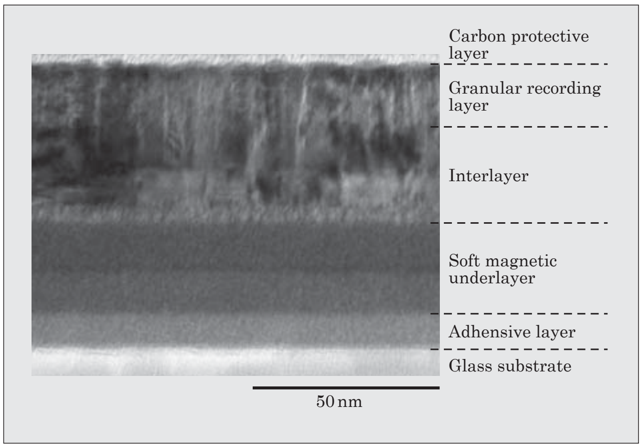


Materials Technology

1 Perpendicular Magnetic Recording Media with Ultra-High Density

Since higher recording capacity is continuously required for hard disk drives, Fuji Electric has commercialized 3.5-inch aluminum disk media with the capacity of 1 TB per platter and 2.5-inch glass disk media with that of 500 GB per platter. Low noise characteristics together with high writeability have been achieved by the optimization of the materials and the microstructures of multilayered granular magnetic layers and interlayers. In addition, the reduction of the magnetic spacing has been realized by applying a new lubricant material with enhanced bonding with a protective layer. Furthermore, along with the development of the advanced evaluation technology, such as the experimental evaluation of the recording performance by using hard disk drives and the improvement of the detection capability of nano-sized defects for higher recording density, Fuji Electric promotes further capacity improvement in order to overcome the competition against the semiconductor memories.

Fig.11 Cross-section TEM image of perpendicular recording media

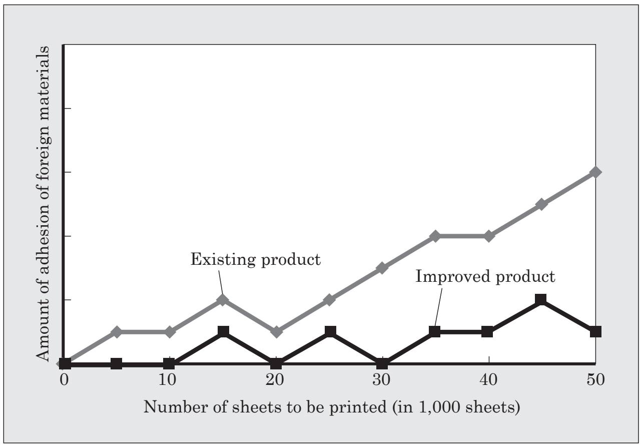


2 High-Durability, Negative Charging Type of Organic Photoconductors

In the digital printing field, devices with various functions are coming on the market each day along with the diversification of market needs. As a result, a wide range of products for peripheral components, such as a charging roller and cleaning blade, which come into contact with a photoconductor have been developed. For this reason, a photoconductor with excellent matching property with a peripheral component with a wide variety of properties and qualities are in demand.

Fuji Electric is developing a high-durability organic photoconductor that matches with these members. In order to increase durability against physical load to the photoconductor due to each member, development and formation of new material was adjusted and toughness of the layer, strength against anti-creep property and anti-cracking property were improved. As a result, the mechanical property of the photosensitive layer was improved and the amount of foreign materials that adhered, which is attributable to damage on the photosensitive layer caused by each type of contacting member, was reduced.

Fig.12 Amount of foreign materials adhering to surface of photoconductor in printing test



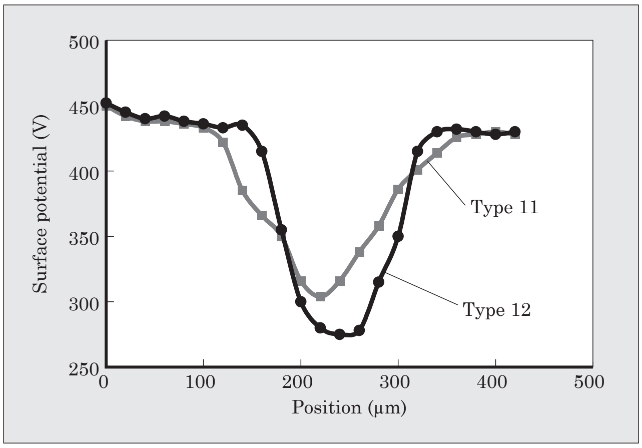
3 High Response and High Sensitive Double Layer Organic Photoconductor for Positive Charging

Electrographic imaging devices have become high-speed, high-resolution and colorized and there is a strong demand to reduce their size and price. Organic photoconductor (OPC) must satisfy requirements at a high-performance for sensitivity, responsiveness, durability, resolution, reliability and cost.

Fuji Electric has been launching on the market the multi layer OPC for negative charging (Type 8B) which can hardly achieve both high-speed and high-resolution and the single-layer OPC for positive charging (Type 11), which can relatively easily to achieve both. To meet increasing technical demands, Fuji Electric has newly gathered its own technologies and developed the ultra-sensitive double layer OPC for positive charging (Type 12) with excellent responsiveness, resolution, durability and reliability.

The figure shows a comparison of the electrostatic latent image of two types. Compared to the Type 11, the Type 12 has a sharper curve in surface potential and it is clear that image quality with higher resolution can be obtained.

Fig.13 Electrostatic latent image of positive charging OPC



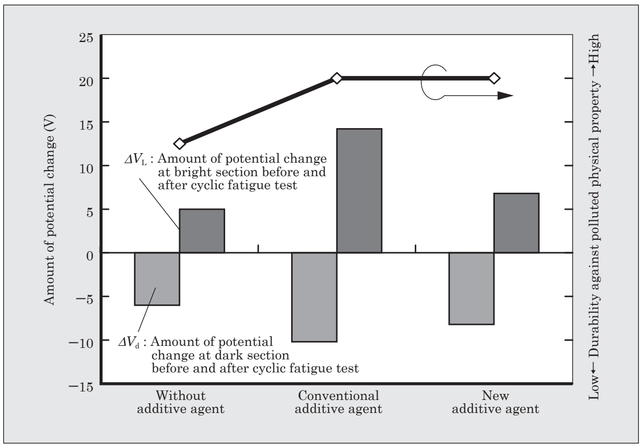
4 Durability Enhancement of Photoconductor Using New Additive Agent

There is an increasing demand for more durable photoconductors due to a trend toward reducing the environmental impacts of printers and plain paper copiers (PPCs) on which a photoconductor is installed. These products need to be made smaller, consume less energy, and made recyclable. In addition, photoconductors are required to have durability for plasticizers, which are included in peripheral attachments such as electrified rollers, and substances that derive from the surrounding environment.

Fuji Electric designs optimal additive agents in the development of functionality materials for photoconductors by considering a design that is not easily influenced by external factors, and increases the flexibility of the design by combining with film-forming material.

New additive agents can provide photoconductors with a more flexible design by improving the stability of the electrical potential with a small amount of potential change under a high-temperature and high-humidity environment under the same conditions while maintaining crack-tolerance property.

Fig.14 Durability-enhancing effects of photoconductor using new additive agent



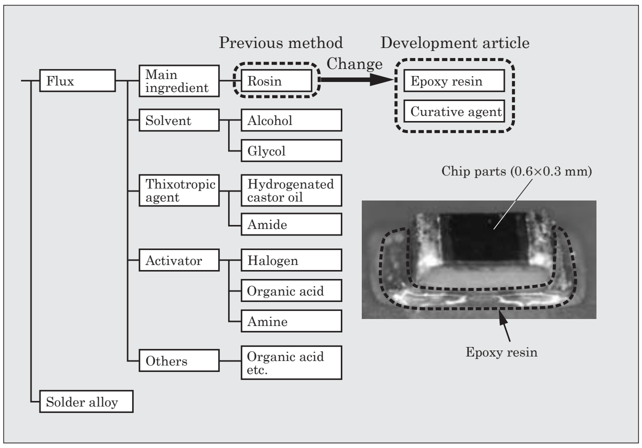
5 Epoxy Resin Cream Solder for Reinforcement of Joints for Microchip Parts

An effective way to implement high-density printed circuit boards and to reduce the size of devices is to use microchip parts (0.6×0.3, 0.4×0.2 mm). However, because the solder bond section of microchip parts is reduced, the bond strength becomes weaker.

Fuji Electric has developed cream solder flux that can reinforce the bond strength by changing the existing flux ingredient from rosin resin to epoxy resin. This is used to reinforce the solder bond section by using heat processing when joining with solder and by hardening the epoxy resin at the same time. The soldering properties such as wetting are equivalent to the original rosin resin by adding an appropriate activator.

In the future, Fuji Electric will optimize reflow conditions of this flux in order to apply to actual products, and promote its application to new products.

Fig.15 Material composition of cream solder and example of joint of microchip parts



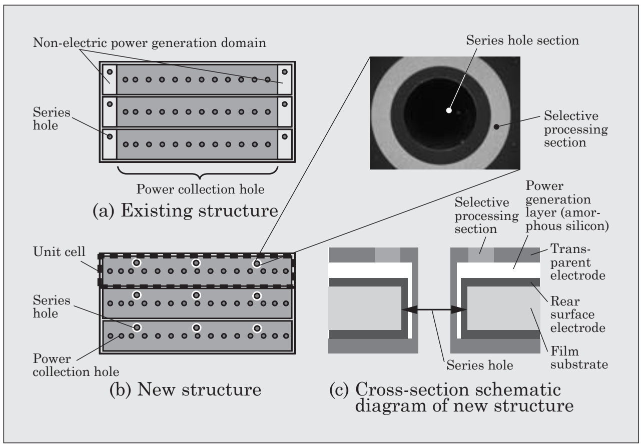
Materials Technology

6 Low-Loss Series-Connection Technology for Film Substrate Photovoltaic Cells

Fuji Electric has developed technology for selective laser processing to remove thin transparent electrode layers on amorphous silicon generation layers without causing thermal damage to the generation layers. This technology is used to process the groove of the ring shape by using an excimer laser all at once.

The photovoltaic cells of Fuji Electric have a unique series-connection structure. The photovoltaic cells, which are divided into units, are electrically connected through series holes and power collection holes. With this processing technology, it has become possible to align freely the series hole (Fig. (b)), which used to be aligned to both ends of the unit (Fig. (a)). As the result, the current that flows into the metal electrodes is divided and the output of the cell has been improved by 5% due to a decrease in resistance loss. Furthermore, it has become possible to change the non-electric power generation domains of both ends of the unit into the generation domains, thereby further improving output by 5%.

Fig.16 Low-loss series-connection photovoltaic cells using selective laser processing



Incubation Technology

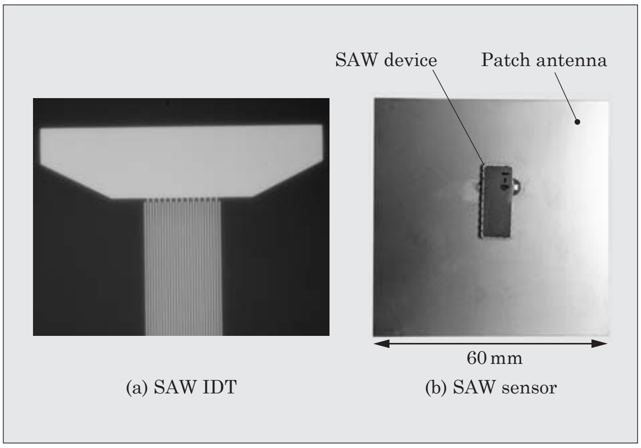
1 Batteryless and Wireless Sensing Technology

Fuji Electric has developed sensing technology that does not require a power line and a battery for a visualization sensor used in data centers and display cases. This technology utilizes a mechanism in which the propagation time when surface acoustic wave (SAW) propagates on a piezoelectric substrate is in proportion to each type of physical quantity (temperature, humidity, and pressure) on the substrate surface. The main features are as follows:

(1) Simple structure composed of SAW sensor installed in the antenna and transceiver with processing circuit.
(2) Battery is not required because radio waves (2.45 GHz) from the transceiver are converted to SAW by inter digital transducers (IDT).
(3) Possible to have multiple channels because multiple SAW sensors can be processed concurrently with one transceiver.

The sensor under development can detect temperatures in the range of −5 to +55°C with an accuracy of ±0.35°C or better and a maximum communication distance of 6 m was achieved.

Fig.17 SAW IDT and SAW sensor



2 MEMS Optical Scanner

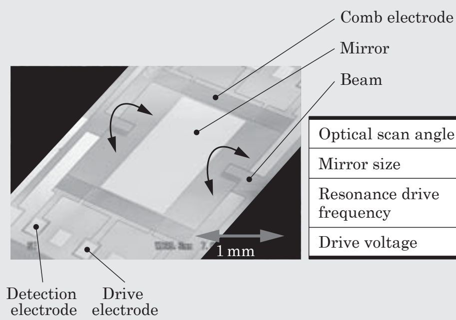
Fuji Electric has been participating in the project of Innovation Center for Medical Redox Navigation, Kyushu University since 2010 and is developing a MEMS optical scanner (device to control the direction of laser beam). in order to apply to medical equipment that requires miniaturization.

Fuji Electric is planning to miniaturize the size of MEMS optical scanner rotating the mirror by electrostatic force between movable electrode and fixed electrode, formed by using silicon microfabrication technology.

For design, fabrication and characterization, Fuji Electric has developed simulation technology that integrated electronics and mechanics, 3D chip stacking technology with through silicon via (TSV) and low temperature bonding technology using micro bumps.

In the future, Fuji Electric aims to apply these technologies to products such as optical measuring equipment and projectors.

Fig.18 Uniaxial MEMS optical scanner



Optical scan angle	±10 °(1 kHz)
Mirror size	1×2 (mm)
Resonance drive frequency	1 to 20 (kHz)
Drive voltage	to 20 V

(a) SEM image (b) Specifications

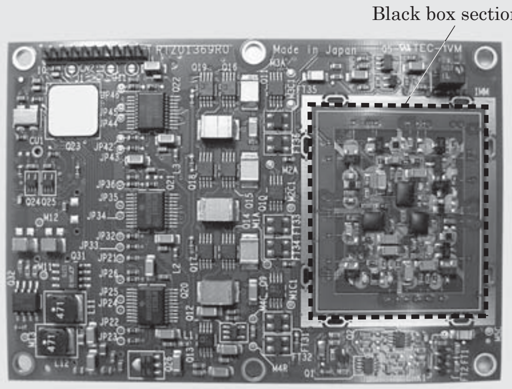
Incubation Technology

3 Black Box Technology for MEMS Sensors

Fuji Electric is carrying out research and development on various types of sensors by applying micro electro mechanical systems (MEMS), which make it possible to differentiate Fuji Electric's products from those of competitors in areas such as size and performance. MEMS sensor signal processing section (analog circuit) is one of the core technologies and a measure is required to prevent competitors from imitating the circuit section for global deployment. In order to achieve this, Fuji Electric is working to develop technology to apply an intelligent micro module (IMM) by using an interposer such as a silicon substrate to the low-noise circuit section, which is used for a MEMS sensor, and create a black box. Through this, obfuscation of circuit section is achieved, and it will be possible to reduce the product's size by 40% compared with the existing surface ratio.

Fuji Electric has applied this technology to vibration sensors and completed development in FY2012.

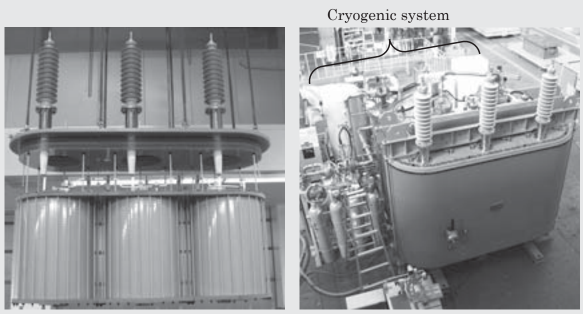
Fig.19 Application example into vibration sensor



4 66 kV/6.9 kV-2 MVA Three-Phase Superconducting Power Transformer

Fuji Electric aims to realize stable and efficient power supply systems and carried out research and development on a superconducting power transformer as a part of "Technological Development of Yttrium-based Superconducting Power Equipment." The project was a joint collaboration mainly with Kyushu Electric Power Company, lncorporated and International Superconductivity Technology Center and was entrusted by New Energy and Industrial Technology Development Organization (NEDO). The five-year project was completed in February 2012. In this project, Fuji Electric aimed to implement a 66 kV/6.9 kV 20 MVA-class superconducting power transformer to develop several elemental technologies such as a fault current limiting function and reduction for AC losses of superconducting windings. Finally, we have developed and evaluated a 66 kV/6.9 kV 2 MVA-class superconducting power transformer comprising the developed technologies. The achievement has reflected to the design of a 20 MVA-class superconducting power transformer.

Fig.20 66 kV/6.9 kV-2 MVA three-phase superconducting power transformer



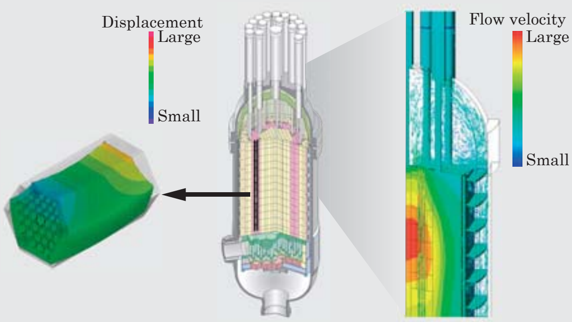
(a) Superconducting transformer winding pack (for three phase)

(b) 2 MVA superconducting power transformer

5 Modular High Temperature Gas-Cooled Reactor with Fully Passive Safety Features

A modular high temperature gas-cooled reactor (modular HTGR) is a next-generation nuclear reactor that has features as follows: (1) it has fully passive safety features, such as that it can be cooled by natural phenomena after an emergency shutdown; and (2) it can supply high temperature heat to realize various heat applications, such as hydrogen production and process heat for chemical plants. Toward the goal of commercialization of the modular HTGR, Fuji Electric is pursuing its R&D effort to achieve the enhancement of passive safety features, higher outlet temperature and higher fuel burnup of the HTGR reactor. Some of these are performed as cooperative research work with Japan Atomic Energy Agency. Relating to the enhancement of the passive safety features, the development of design technology for temperature behavior and structural integrity evaluation of the reactor components during a passive reactor cooling mode are being performed. As to higher outlet temperature and higher fuel burnup of the reactor, development of the evaluation technology for the fuel block deformation by neutron irradiation and thermal expansion, resulting core bypass flow rate fraction and so on are also performed.

Fig.21 Example of fuel block deformation analysis and thermal hydraulic analysis results



Analysis of fuel block deformation under extended burnup condition

Nuclear reactor

Thermo hydraulic analysis during passive cooling mode (velocity distribution)

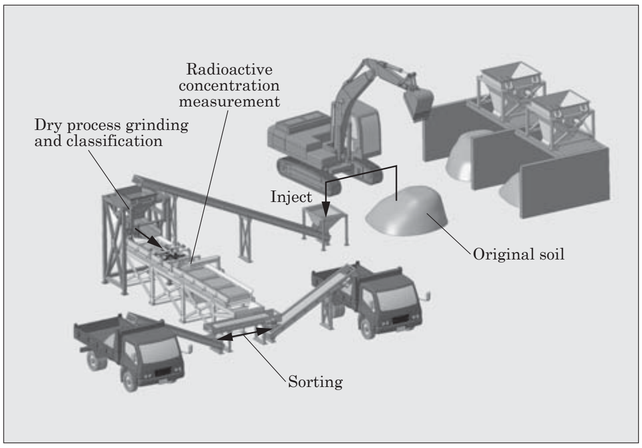
Incubation Technology

6 Dry Decontamination and Volume Reduction Facility for Contaminated Soil

Fuji Electric has developed a facility to separate highly contaminated soil from soil that was contaminated by the accident of Fukushima Daiichi Nuclear Power Station due to the Great East Japan Earthquake. In the contaminated farmland, the top layer of soil down to a depth of a few centimeters is removed to decontaminate. This soil is temporarily placed in an interim storage location, and then finally disposed. However, a wide area of land requires decontamination and a large area is needed to store the entire amount of removed soil. The original soil to be disposed is not contaminated entirely and if highly contaminated soil can be separated from less contaminated soil, it will be possible to reduce the amount of soil that needs to be stored.

This facility is used to reduce the volume of contaminated soil by separating highly contaminated soil from less contaminated soil by means of a dry process grinding and classification. In addition, the total amount of low-contamination soil is 100% verified and its safety is confirmed. The aim is to reduce the space needed for storing contaminated waste and guaranteeing safety and security related to the reuse of processed soil.

Fig.22 Facilty for dry decontaminating and reducing the volume of contaminated soil



Fuji Electric
Innovating Energy Technology