●Basic Stage

Others

(Fiscal Year 2002-2004)

Hachinohe Area

Development of a High-Energy-Utilization System for Woody Biomass

Intelligent Plaza Hachinohe, Inc.
1-4-43 Kita Inter Kogyo Danchi, Hachinohe City, Aomori 039-2245 JAPAN
TEL: +81-178-21-2111

Core Research Organization
Hachinohe Institute of Technology

Major Participating Research Organizations
Industry···ULVAC TOHOKU, Inc., Sasaki Corporation, IHI Corporation
Academia···Hachinohe Institute of Technology, Hachinohe National College of Technology
Government···Aomori Industrial Research Center

Main Results of City Area Program

1. Development of an absorption refrigerator that produces subfreezing cold brine from a low-temperature heat source

In a conventional absorption refrigerator, a heat source with a temperature of around 110°C or above is required. We developed an absorption refrigerator that can be driven by a low-temperature heat source of less than 100°C, using a new type of working fluid. The new fluid is made of LiBr-H_2O with added 1,4-dioxane that changes the structure of the water such that the saturation temperature is decreased. Moreover, we succeeded in reducing the solidifying point of the new refrigerant H_2O-1,4-dioxane to –5°C, and demonstrated the successful manufacture of subfreezing cold brine using a single-effect-type absorption refrigerator. We also developed a densitometer that measures the concentration of the working fluid in real time.

Experimental setup for the prototype absorption refrigerator

2. Development of a gasification furnace for woody biomass

We achieved a gasification conversion efficiency of 70%, and the heating value of the produced gas was 4,000 kJ/Nm³. The gas fuel has sufficient heating value for application in gas engines and gas turbines. Moreover, the newly developed fluidized catalyst and reforming flow method are effective in achieving a high heating value in the produced gas, improvement in conversion efficiency, and control of tar generation. The basic design of the fluidized bed gasification furnace (e.g., optimal catalyst and chip particle sizes) was obtained according to the flow condition of the catalyst and biomass chip.

Test setup for the gasification of woody biomass

Approaches after Completion of Project

1. Development of an energy-saving absorption refrigerator

Based on the technology developed as part of this research, we are now improving the different elements of the absorption refrigerator model, and studying the properties of the working liquid and the design of new cycles in order to develop an absorption refrigerator driven by a heat-source with the temperature of the exit of a conventional solar collector. We also intend to reduce the temperature of the manufactured cold brine to -10°C. We will then be able to miniaturize the indoor fan-coil unit, use the cold brine for the freezer, and produce the chilled water (0°C) that is required in large volumes in the food manufacturing industry. We also aim to develop a cold manufacturing system for a stand-alone air conditioning unit combined with a solar cell or wind power, thereby realizing zero-emission air-conditioning in tropical areas and regions with poor electric power supply. Based on the results achieved to date, and by promoting R&D, we intend to commercialize a new type of absorption refrigerator characterized by energy savings and/or the capability to manufacture subfreezing cold brine.

2. Technical approach to an energy-efficient system for woody biomass

In the supercritical water gasification process, prior liquefaction of woody biomass is useful in improving the conversion efficiency and inhibiting tar generation. Therefore, an experiment was performed to investigate the characteristics of the liquefaction of cellulose (the main component of woody biomass) treated by hot compressed water, thereby revealing the optimal water temperature and pressure for the liquefaction of cellulose. Moreover, we clarified the chemical reaction that accompanies the decomposition of cellulose to oligosaccharides, monosaccharides, and pyrolysis products. We have begun research into the reaction system required for efficient hydrogen-rich manufacturing. It is expected that the produced gas fuel will be utilized for a power generation system in the near future using fuel cells. In addition, the low-temperature reforming catalyst developed to accelerate effective gasification and inhibit tar generation is effective in gasification furnaces such as rotary kilns. We aim to commercialize this product as a high-performance catalyst.

Test equipment for supercritical water gasification

●Basic Stage

Nanotech Materials

(Fiscal Year 2002-2004)

Kitakami River Basin Area

Research and development into the high-performance organic nanomembrane triazine thiol

Iwate Industry Promotion Center
(under Advanced Science and Technology Institute of Iwate)
3-35-2 Iioka Shinden, Morioka City, Iwate 020-0852 JAPAN
TEL: +81-19-631-3820

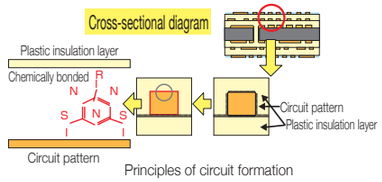
Core Research Organization
Iwate University

Major Participating Research Organizations
Industry···Toadenka Co., Ltd., Nippon Chemi-Con Corp., KM ACT Ltd., Toany Co., Ltd.
Academia···Iwate University
Government···Iwate Industrial Research Institute, Iwate Industry Promotion Center

Main Results of City Area Program

1. Establishment of a new production method for high-density build-up circuit boards

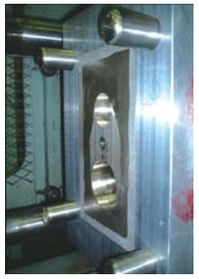
The general method of producing the circuit pattern for printed circuit boards involves exposing the smooth surface of copper foil to etching treatment, thereby enabling adhesion with the epoxy-resin circuit board. However, in the present R&D program, a high-performance organic nanomembrane (a derivative of triazine thiol) was applied to the surface of the epoxy-resin circuit board, thus establishing a new high-adhesion technique that renders the etching process obsolete. Compared with existing production techniques, we achieved a large decrease in the environmental burden and cost of production. Trial manufacturing has been successful in producing high-density build-up circuit boards capable of operating at high frequencies.



Principles of circuit formation

2. Establishment of a high-accuracy electrocast metal mold manufacturing technique and a high-endurance release metal mold coating technique

In seeking to improve the manufacturing technique used for electrocast metal molds, a derivative of triazine thiol has been introduced to the adhesive process used for bonding electrocast molds (nickel type) with a composite body (consisting of metallic powder and epoxy resin) that forms the back-up ingredients for the mold. Triazine thiol has also proven to be effective in the manufacture of the composite body. Compared with existing processes, use of the triazine thiol derivative has paved the way for a fast, cost-effective, and highly accurate electrocast mold manufacturing technique. Furthermore, by coating the release mold in triazine thiol containing fluorine during epoxy-resin molding processes, it has been possible to realize functional high-endurance mold release that requires relatively little release agent.
By establishing a uniform release mold technique for uneven, complex surfaces, we successfully produced metal molds for making Fresnel lenses and other intricate nano-shapes, as well as LSI circuit encapsulation.



Electrocast metal mold (concept model)

Approaches after Completion of Project

1. Promotion of the development of new manufacturing techniques for next-generation printed circuit boards

We intend to undertake further research into the adhesiveness of smooth surfaces such as copper foil and epoxy resin, as demonstrated in this research program, as well as publication of the major scientific results. Using the high functionality of triazine thiol, we plan the development of a metal plating technique that exhibits good adhesion with various materials (e.g., plastics, ceramics, and glass), and the realization of high-performance nano-printed circuit-board manufacturing techniques and three-dimensional circuit molding techniques for mobile telephones. The future will see the further expansion of this research, with the development of built-in organic element ‘system-in packages’ and scheduled adaptation in line with the transition to electronic manufacturing in the auto industry. This research was adopted by the Science and Technology Incubation Program in Advanced Regions (2006-2008).

2. Promotion of new developments related to metallic molds

R&D has been promoted in Iwate through the Government–Industry–and Academia Cooperative Research and Development Project (2006-2008), an undertaking unique to the prefecture that aims to commercialize a high-accuracy electrocast metal mold manufacturing technique and high-endurance release metal mold coating technique. The high-accuracy electrocast metal mold manufacturing technique will be used in the production of car bumpers and other large components, but will also be applied to the manufacture of optical lenses and LEDs. Furthermore, in reference to the high-endurance release metal mold coating technique, we will promote R&D that aims to be adaptable to the metal mold industry’s expected market demand for electrocast molds (nickel plated).

●Basic Stage

Nanotech/Materials

(Fiscal Year 2002-2004)

Yamagata Yonezawa Area

Development of New Carbon Materials and a Secondary Lithium-ion Cell with High-speed Charging and Discharging

Yamagata Promotional Organization for Industrial Technology
2-2-1 Matsuei, Yamagata City, Yamagata 990-2473 JAPAN
TEL: +81-23-647-3163

Core Research Organization
Yamagata University

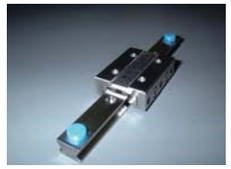
Major Participating Research Organizations
Industry···Sanwa Oil & Fat Co., Ltd., YAMAMOTO CO., LTD., ENERSTRUCT INC., and others
Academia···Yamagata University

Main Results of City Area Program

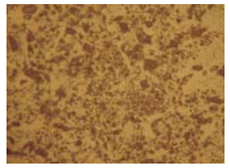
1. Development of high-strength and highly water-resistant rice-bran carbon material, and production of new carbon material made from rice hull

We markedly improved the strength and water-resistant properties that were problematic in original rice bran carbonized materials. The usage of this material has expanded greatly, including the development of bearings for use in fields that require great strength and water-resistant properties.

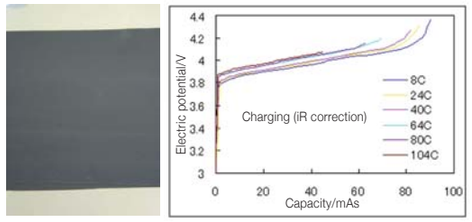
Moreover, we succeeded in producing a new carbon material, “RHS carbon,” made from rice hull. Since the material has excellent water-resistant properties, it is expected to find use in high-performance friction elements, and as functional fillers for rubber composite materials.



Direct bearing made from porous carbon materials



Burned chaff material, RHS carbon

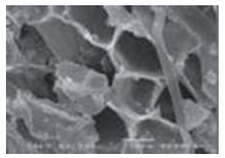


Electrode prototype and its characteristics (charging)

2. Success in the trial manufacture of an electrode with rapid electrical charge and discharge

We clarified the factors governing the electrical charge and discharge speed of a battery, and succeeded in the trial manufacture of an electrode that enables electrical charge and discharge in 30 seconds.

Approaches after Completion of Project



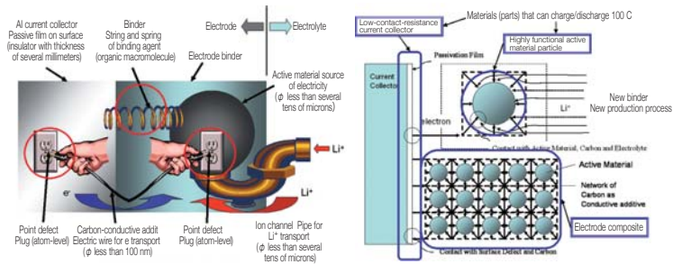
Natural porous structure of chaff

1. Improvement and application of high-performance porous carbon materials

R&D into friction elements has been carried out in collaboration with SANWA YUSHI Co. Ltd. The research group received a grant from the Ministry of Agriculture, Forestry and Fisheries of Japan (for 2007-2009). The group has already succeeded in producing highly reliable materials for friction elements. Moreover, the powdered form of porous carbon material could be used as functional filler for conductive rubber-composite materials. This research topic has been awarded a JST grant (for 2008), and has been investigated by manufacturing corporations and researchers at Yamagata University.

2. Application to a power system of a lithium-ion secondary battery with high-speed electrical charge and discharge

We developed the basic technology required to optimize the electrode components of a lithium-ion secondary battery, clarified the complex electrode components and functions, and established the principles behind its rapid charging and discharging. Furthermore, we developed the production technology required to create an electrode structure for practical use in a battery to be applied as a secondary battery for electric vehicles. We confirmed that porous carbon material functions efficiently as a negative electrode for a lithium cell; expectations are now turned toward practical use. The project has now passed onto a venture company, with the aim of constructing a battery manufacturing base in the US market.



Optimized model of electrode function and structure」

●Basic Stage

Life Sciences

(Fiscal Year 2002-2004)

Koriyama Area

Support for Next-generation Surgery Using Haptic Technology and Development of Medical Diagnosis Equipment

Fukushima Prefecture Industrial Promotion Center
1-12 Machiikedai, Koriyama City, Fukushima 963-0215 JAPAN
TEL: +81-24-959-1951

Core Research Organizations
Nihon University College of Engineering, The University of Aizu

Major Participating Research Organizations
Industry···ASTER INDUSTRIES Co., Ltd., P&M Co., Ltd., IR Medical Laboratory Co., Ltd.
Academia···Nihon University College of Engineering, The University of Aizu, Fukushima Medical University
Government···Fukushima Technology Centre

Main Results of City Area Program

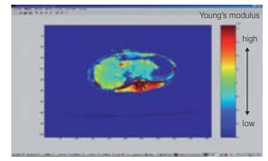
1. Development and clinical application of a palpation probe for surgical support

Generally, doctors perform manual evaluation during surgery by palpating the liver or artery blood sedge, but it is difficult to assess soft vs. hard in the clinical setting. It is also difficult to gain direct manual access now that endoscopes are commonly used. Therefore, a need exists for the development of haptic technology that quantitatively evaluates texture (as sensed by touch) using a sensor and instrumentation system in the clinical setting. We confirmed the utility of a tactile sensor that has characteristics that approximate palpation using the phase shift method, as initially developed as part of the City Area Program (Basic Stage). Tests on animals during imaging were successful in performing real-time measurements of the hardness of specific areas of internal organs. This technique is scheduled to be applied clinically on a real-time basis, and other practical uses are envisaged in the future.

Palpation probe to support surgery

2. Practical use of an imaging system to evaluate hardness using X-ray CT

Physical information regarding characteristics of the hardness and softness of tissue such as tumors cannot be acquired directly from CT images obtained using the current X-ray CT system. Diagnosis of the hardness of cirrhosis and liver cancer has been achieved using a probe that obtains an image from the obtained calibration curve for correlation with Young's modulus, as measured based on the transmission X-ray strength of X-ray CT, and a tactile sensor for testing the hardness. Some of the resulting technology has been transferred to a software company.



Imaging of the hardness of liver cancer in rabbits using X-ray CT values

Approaches after Completion of Project

Measurement of hardness of the zona pellucida of ovum

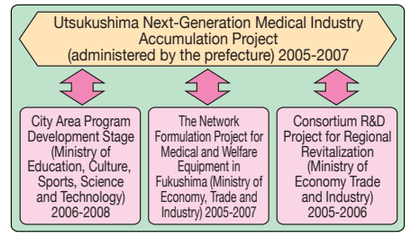
1. Advanced functionalization and application of haptic (sense of touch) technology via the collaboration of medical science and engineering (Development Stage)

Research and development continues from the City Area Program (FY2006) with the development of a medical-equipment-related business platform, with the aim of developing a new diagnostic technology for quantitative evaluation using sensors and measurement systems based around a haptic technique, the next generation of robotic arms and hands with soft touch, and application of the new medical support system.

2. Approach to the formation of an industrial cluster for medical and welfare equipment

The industrial policy for specialization in the medical equipment industry is leading to good progress in Fukushima Prefecture. To correspond to Death Valley, approval process for medical devices, corresponding animal tests and their clinical examination, and formation of the “Utukushima Next-generation Medical Industry Accumulation Project,” which included support systems for the transition to commercialization. Moreover, the “Medical Creation Fukushima” event was held as an opportunity for interaction between business interests and developers of medical equipment, with the aim of forming a medical-equipment-related business platform.

The development of a haptic sensor as a result of the City Area Program (Basic Stage) continued in cooperation with Tohoku University (employing the MEMS technique) as a consortium research and development project for regional revitalization, titled “Development of Ultrasonic Diagnosis System with Haptic Technology using MEMS Technique” as part of the Local New Consortium Research and Development Program (FY2005-2006).



Support system in Fukushima Prefecture for the development and practical application of medical devices

●Basic Stage

Environment Others

(Fiscal Year 2002-2004)

Kasumigaura Southern Coastal City Area

Development of an Integrated Processing/Recycling System for Food- and Livestock-Related Biomass

The Science and Technology Promotion Foundation of Ibaraki
1853 Okijyukumachi, Tsuchiura City, Ibaraki 300-0023 JAPAN
TEL: +81-29-830-3036

Core Research Organization
The Science and Technology Promotion Foundation of Ibaraki

Major Participating Research Organizations
Industry···JA ZEN-NOH, Baiolex Co., Ltd., Shintou Co., Ltd.
Academia···University of Tsukuba
Government···National Institute for Environmental Studies, National Agriculture and Food Research Organization, Ibaraki Prefectural Government

Main Results of City Area Program

1. Development of a system to convert food waste and livestock manure into energy

Methane fermentation has been employed in sewage treatment plants and related systems for many years, but a recent focus of attention is methane-fermentation facilities that simultaneously dispose of biological waste and produce energy. In the system we developed, food waste and livestock manure are mixed and the resulting biomass undergoes efficient methane fermentation. The released biogas is combusted to produce electricity and to heat water, and residual liquid from the fermentation is cleaned by an electrochemical process. Thanks to two-phase methane fermentation, this system reduces the fermentation time to less than half that previously required, and also reduces the size of the facility by half. With the reduction in construction costs and other expenses, this system is expected to be commercially viable.

Illustration of the entire biomass energy recovery system

2. Establishment of a system to stabilize and reuse methane-fermentation residue and solid waste such as sludge

We investigated the possibility and utility of carbonization (reduction/heat treatment) as a means of reducing the volume and increasing the reusability of organic waste products released in the process of treating livestock waste. It became clear that as the temperature of carbonization increases, the resulting carbon becomes more basic. It also has a much smaller surface area and larger pores than chemically processed activated carbon, and is consequently appropriate for the removal of large-diameter pollutants. This process is expected to find use in situations that involve the production of large amounts of organic solid waste, such as livestock farms and sewage treatment plants.

Equipment required for the waste carbonization (reduction and heat treatment) process (rotary kiln)

Approaches after Completion of Project

1. Installation of Hybrid Biomass-Conversion Systems

The Research Institute of Tsukuba Biotech Ltd., founded by the leader of the Biomass Energy Conversion Systems Development Group, Dr. Maekawa (formerly of Tsukuba University), has developed a Hybrid Biomass-Conversion System by adding a drum dryer to their previously established Two-Phase Methane Fermentor. The solidified substance formed after the drying process is used as pellet fuel. In June of 2007, a privately-held factory in the town of Umi, Fukuoka Prefecture, installed, and continues to use, a Stirling engine-equipped Hybrid Biomass-Conversion System with the operational capacity to produce 4.9 t/d without the need for external electric power.

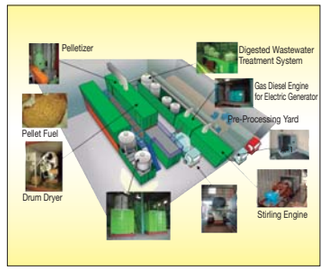


Illustration of the Hybrid Biomass-Conversion System

2. Development of a technique to transform bottom sediment from China's Suzhou River into a useful resource

Due to waste water from dye factories that once lined both sides of the Suzhou River where it runs through Shanghai, the river-bottom sediment is polluted with toxic substances such as heavy metals and dioxins. When we treated this complexly polluted sediment with a pilot version of our two-step carbonization (reduction/heat treatment) equipment, over 99% of the contaminating dioxins were decomposed, and heavy metals such as chromium were almost completely stabilized.

The scale of our plans will be enlarged in the future to achieve an actual plant for this process, in cooperation mainly with Shanghai City.

Equipment required for reduction and heat treatment (experimental site at Shanghai Jiao Tong University)

●Basic Stage

Nanotechnology/Materials

(Fiscal Year 2002-2004)

Kiryu and Ota Area

Research and development into next-generation nano-molding processing

Gunma Industry Support Organization
1-10-7 Owatarimachi, Maebashi City, Gunma 371-0854 JAPAN
TEL: +81-27-255-6601

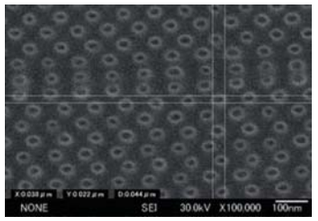
Core Research Organization
Gunma University

Major Participating Research Organizations
Industry···Ogihara Corporation, Miyazu Seisakusho Corporation, Tokyo Parts Industries Corporation, and others
Academia···Gunma University
Government···Gunma Prefecture (Gunma Industrial Technology Center, Textile Research Institute of Gunma), Gunma Industrial Development Center

Main Results of City Area Program

1. Development of nano- and micrometer-scale dies

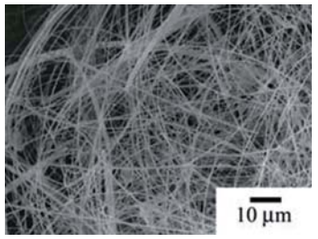
We developed the following technologies: fabrication of nano-dot/pyramid dies by an electron beam lithography and silicon process, development of a laser direct-drawing system as a photolithography machine, creation of micro-dies with high aspect ratio and die-forging of a coil for high-frequency hybrid magnetic elements, fabrication of nanometer-scale dies of various materials, and, using these dies, micro-gears with a diameter of 1 μm. Nano-dot-dies with 40 nm intervals were fabricated using a FIB-machine, and nano-imprinting of a metallic glass was performed using the dies. Interference optical elements such as a grating and a hologram were developed by die forging of metallic glass using dies fabricated by nanometer-scale lithography over large areas by laser interference and successive electroforming.



SEM image of a small bit string: bit size 35 x 50 nm, bit pitch of 100 nm, track pitch of 50 nm

2. Development of a mass-production system for silicon carbide nanofibers

A polymer blend consisting of carbon precursor polymer matrix and fine silicon carbide precursor polymer particles is melt-spun, stabilized, and carbonized. After the removal of carbon matrix in the resulting fibers with a nitric acid solution, the released silicon carbide nanofibers (several hundreds of nanometers in diameter) are recovered. This is just one of many potential methods that might lead to the mass-production of silicon carbide nanofibers. The next tasks are scale-up of the process and characterization of the nanofibers. The nanofibers are expected to be used as a reinforcement filler for metal- or ceramic-based nano-composites, high-quality filters, etc.

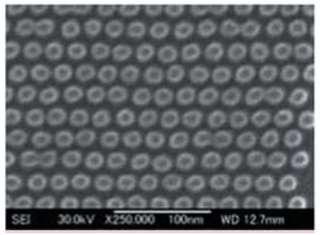


Electron microgram of silicon carbide nanofiber produced using the developed method

Approaches after Completion of Project

1. Development of key technology in terabit patterning for an ultrahigh-density recording disc

This research represents the world-first formation of nano-dot arrays with a diameter of about 13 nm, a track pitch of 25 nm, and a bit pitch of 25 nm in the negative resist using electron beam writing. This corresponds to an ultrahigh-density of about 2 Tb/inch² for an optical disc and about 1 Tb/inch² for the patterned media required for magnetic discs. This is 300 times higher than the density of DVDs available on the market, and even 100 times greater than that of Blu-ray Discs (40 GB). Based on this development, we shall continue to study the application of the technology to achieve an ultrahigh-density recording disc.



SEM image of small bit arrays: dot diameter of 13 nm, bit pitch of 25 nm, track pitch of 25 nm

2. Promotion of R&D into next-generation nano-molding processing

In addition to the above, in our research into a high-frequency hybrid magnetic device we successfully developed a magnetic thin film and mounting coil that can be used in up to 2-GHz-class devices. The recombinant bacterioferritin was prepared using a gene engineering technique and purified for construction of a protein monolayer. Two-dimensional crystals of the bacterioferritin were observed and analyzed by electron microscopy, and are expected to be employed in a novel nano-layout element.

The development of next-generation nano-molding processing has continued even after completion of the project via promotion of the Regional New Consortium R&D Project, as well as making use of cooperative industry-academia-government projects in securing funding. Therefore, the joint projects are being continued in efforts to create a new consortium in the region.

●Basic Stage

Life Science

(Fiscal Year 2002-2004)

Niigata Area

Creation and Expansion of a Nanomedicine Industry that Enables Safety, High Function, and Low Cost

Niigata Industrial Creation Organization
Bandaijima Building 10F, 5-1 Bandaijima, Chuo-ku,
Niigata City, Niigata 950-0078 JAPAN
TEL: +81-25-246-0068

Core Research Organizations
Niigata University, Niigata University of Health and Welfare, Meirin College, Industrial Research Institute of Niigata Prefecture

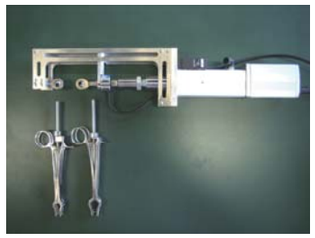
Major Participating Research Organizations
Industry···MORI TEKKO CO., LTD., MIZUHO Co., Ltd., Toushinyoukou Co., Ltd.
Academia···Niigata University, Niigata University of Health and Welfare, Meirin College
Government···Industrial Research Institute of Niigata Prefecture

Main Results of City Area Program

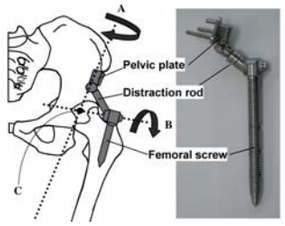
1. "Load-bearing device for hip joints" and "spinal surgery monitoring system" based on the integral analysis of bones and parts

Based on bone structure analysis, we developed a "load-bearing device for hip joints" with the properties of high strength and long life. This technology helps patients to return to their normal lifestyle even after suffering from avascular necrosis of the femoral head or Perthes disease; QOL is guaranteed even during treatment.

The R&D continued, and we developed a registration technique related to optimization of the installation of a next-generation artificial hip joint stem. The technology involves a behavior- and strength-analysis technique of pith, using a developed load-bearing device, for which we have applied for a patent. In the development of a "spinal surgery monitoring system," we are currently evaluating the software; the next step is commercialization.



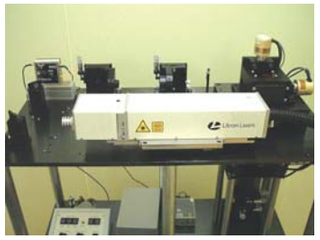
Monitoring system for spinal surgery



Load-bearing device for hip joints

2. Development of a device for lesion location and treatment

The laser-beam scanning method, using a high-precision lens with shrink-fitter technology, enabled application of the laser beam over a wide range. Based on this technology, we developed a "PDT laser treatment device for pimples" and a "laser treatment device for moles," both of which are small and low-cost, as well as a "wide-view laser microscope for skin inspection," with which it is possible to accurately observe the target.

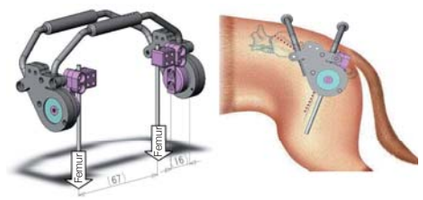


Laser therapy equipment for birthmarks and moles

Approaches after Completion of Project

1. Advanced functions, commercialization, and further R&D

We are continuing with R&D in the Niigata Area and in the Venture Business Laboratory of Niigata University, including improving the functions of the spinal-surgery monitoring system to prevent transmission using 6-degrees-of-freedom movement under physiologic load conditions, and developing advanced functions of laser medical equipment using high-precision lens and scanning technologies. Moreover, the concept of a hip-joint load-bearing device was used effectively in producing highly functional and low-weight locking mechanisms for small animals, in the development of a fracture-fixation device for comminuted fractures, and the development of a registration technique for optimizing stem installation in a next-generation artificial hip joint, based on a device-fixation strength analysis technique in the medullary cavity of the femur.



Fixation device for pelvic fractures in small animals

2. Contribution to health, welfare, and the medical industry

A "Health, welfare, and medical industry vision" has been developed for Niigata Prefecture, supporting approaches concerning health-related business via various measures.

The Niigata Industrial Creation Organization is attempting to expand the medical industry via the "Niigata Medicare Creations" program.

●Basic Stage

Life Science

(Fiscal Year 2002-2004)

Shizuoka Central Area

Establishment of a high-sensitive evaluation system for physical/mental stress, and development of new foodstuffs and medical/chemical materials that act to reduce stress

Shizuoka Organization for Creation of Industries
Shizuokaken Sangyo Keizai Kaikan 4F, 44-1 Otemachi, Aoi-ku, Shizuoka City,
Shizuoka 420-0853 JAPAN
TEL: +81-54-254-4512

Core Research Organizations
University of Shizuoka, Shizuoka University,
Shizuoka Industrial Research Institute of Shizuoka Prefecture, Tokai University

Major Participating Research Organizations
Industry···Hamamatsu Photonics K.K., Maruhachi Muramatsu Corp., Yaizu Suisankagaku Industry Co., Ltd., and others
Academia···University of Shizuoka, Shizuoka University, Tokai University, and others
Government···National Agriculture and Food Research Organization, Shizuoka Industrial Research Institute of Shizuoka Prefecture, Shizuoka Prefectural Fisheries Experiment Station, and others

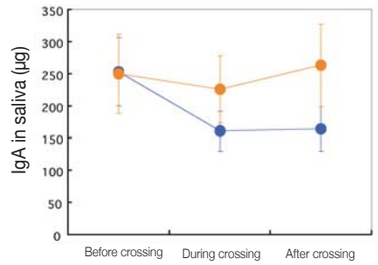
Main Results of City Area Program

1. Developement of a physical- and mental-stress evaluation system using an ultra-weak chemiluminescence measurement system

The developed ultra-weak chemiluminescence-based system is more sensitive in measuring physical and mental stress than chemical analysis using immunoglovulin and amylase. This method will be applied to evaluate the degree of relaxation in several behaviors while bathing in hot springs.

2. Successful business producing foods with anti-physical/mental stress properties

Professor Yokogoshi and others at the University of Shizuoka induced height-fear stress in volunteers by asking them to cross a suspension bridge. During the experiment, a group who took γ-aminobutyric acid (GABA) showed an increase in stress markers such as IgA and chromogranin A in saliva compared with the control group. GABA-containing chocolate products are currently being brought to the market. Other groups within our organization are currently developing tea drinks and bonito-ovary-oil products that show anti-physical/mental stress characteristics.



Fear-control effect of GABA intake when crossing a suspension bridge

Approaches after Completion of Project

1. Analysis and evaluation of physical/mental stress using stress-free instrumentation technology based on light

The aim of this program is to determine the degree of physical/mental stress by ultra-weak chemiluminescence. Chemical analyses reveal that IgA and amylase are useful markers in saliva; however, the ultra-weak chemiluminescence technique shows higher sensitivity than chemical analysis. Following the establishment of the evaluation system for physical and mental stress, we are currently collecting relaxation data in an experiment conducted at a hot spring. This research will contribute to the creation of new businesses in the fields of food, medical, and chemical products.

2. Production of foods effective against physical and mental stress and lifestyle-related diseases

We searched among the special food products of Shizuoka Prefecture for ingredients effective in reducing physical and mental stress and that are effective against lifestyle-related diseases. Bonito ovary oil has been proven in animal experiments to combat stress. It is planned to use this ingredient in pet foods on a commercial basis.

Research into sugar chains, as conducted by local universities, is also to be advanced with the aim of creating new opportunities to commercialize chemical products such as reagents.

Example of research results
(including samples and products under development)

●Basic Stage

IT

(Fiscal Year 2002-2004)

Toyohashi Area

Development of a Smart-Sensing System

SCIENCE CREATE Co., Ltd.
333-9 Nishi Miyukicho Aza Hamaike, Toyohashi City, Aichi 441-8113 JAPAN
TEL: +81-532-44-1121

Core Research Organization

Toyohashi University of Technology

Major Participating Research Organizations

Industry···Advance Food Technology Co., Ltd., Alpha Project Co., Ltd., Japan Operator Co., Ltd., etc.
Academia···Toyohashi University of Technology
Government···National Food Research Institute

Main Results of City Area Program

1. Metal-contaminant detection device using high-Tc SQUID

Developer: Advance Food Technology Co., Ltd.
Saburo Tanaka, Professor, Toyohashi University of Technology

This device is able to detect foreign objects made of magnetic metal in the order of 100 microns in size, regardless of the shape of the target object (e.g., aluminum, resin, glass). The method requires no complex adjustments, measurement errors are minor, and the device is extremely reliable. The device is appropriate for analysis of a wide range of raw materials and products, including packaging and pharmaceutical products.

Metal-contaminant detection device using high-Tc SQUID

2. Compact surface-analysis system

Developer: Alpha Project Co., Ltd.
Hironaga Uchida, Associate Professor, Toyohashi University of Technology

This product is a compact, high-performance scanning tunneling microscope (STM) for the observation of atoms and molecules on material surfaces under atmospheric conditions. The STM is 74 mm in diameter and 98 mm high. Scanning range is 0-600 nm in the X and Y directions, and 0-1200 nm in the Z direction. The STM controller is 180 mm high, 360 mm wide, and 230 mm deep. It uses a digital control method with a scanning rate of 6-600 sec/frame for 512 x 512 pixels. The device enables scanning tunneling spectroscopy (STS) and measurements of an external signal synchronized with scanning.

Compact surface-analysis system

Approaches after Completion of Project

In order to extend the achievements of the project titled “Development of a Smart Sensing System” of the previous City Area Program (Basic Stage) and to develop a new research field, we are currently involved in (1) the development and application of a smart sensing system for supporting industry, and (2) the development and application of a smart sensing system that combines IT and agriculture. While the achievements of the previous City Area Program were based on measurement, production, and communication technologies, the present program (Development Stage) is expected to be more beneficial to the local area because it would ensure the future application of industrial products and develop emerging markets. Subproject (2) is focused on agricultural business in the local area. With the development of new products, our new technology is expected to contribute to a new type of agricultural business in the near future, the so-called “Precision Agriculture” of the 21st century.

Project Concept Diagram

Toyohashi University of Technology (joint research with private companies)
seeds of technology (development of smart sensing system)
Tests
Validation Field
Local resources (precision agriculture, medicine and welfare, environmental conservation, non-destructive tests, etc.)
Technological transfer
New technology introduced by regional companies
Production
Accumulation of local industries

●Basic Stage

Nanotech Materials Others

(Fiscal Year 2002-2004)

Harima Area

Development of New Functional Materials with Quantum Beam Technology

Hyogo Science and Technology Association
3-1-1 Koto Kamigori-cho Ako-gun, Hyogo 678-1205 JAPAN
TEL: +81-791-58-1415

Core Research Organizations

University of Hyogo, Toyota Technological Institute

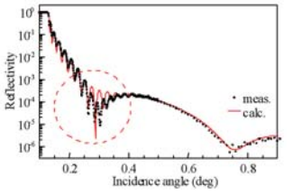
Major Participating Research Organizations

Industry···SYONAN NITRIDING Co., Ltd., KURITA Seisakusho Co., Ltd., PLUS. Co., Ltd., and others
Academia···University of Hyogo, Toyota Technological Institute, and others
Government···Hyogo Prefecture, Hyogo Science and Technology Association, The New Industry Research Organization

Main Results of City Area Program

1. Development of a Technique for Ultrastructure Analysis Using a Synchrotron Radiation X-ray Microbeam

X-ray reflectivity measurement is effective in evaluating laminated structures of thin and multilayer films, the density distribution of such films, surface and interface roughness, and film thickness in both crystalline and noncrystalline materials. This project, using the high-brightness synchrotron radiation at SPring-8, made it possible to develop new techniques of extremely high precision and resolution compared with traditional techniques. Use of the synchrotron X-ray microbeam was extremely effective as an analytical tool for DLC films in terms of improving adhesive properties and increasing film density.



X-ray reflectivity of DLC thin films

2. Evolution of the “Plasma-Based Ion Implantation & Deposition System” into Fully Automatic DLC Film-Formation Equipment

The Plasma-Based Ion Implantation & Deposition System, which won the 2nd Japan Manufacturing Grand Prix Excellent Prize, has evolved into fully automatic DLC film-formation equipment in response to requests for a reduced workforce and lower costs from customers in the surface modification industry. Corresponding to DLC film formation for large parts, we developed equipment for which the size of the vacuum vessel was enlarged to a diameter of 1.2 m, and the body length to 2 m; the output capacity of the pulsed power supply was doubled. Our ongoing R&D has enabled large materials to be coated by DLC films in a fully automatic manner. The system is now applicable to various structural parts due to increased publicity and attention from the general industrial-machinery manufacturing industry and the semiconductor manufacturing industry. DLC thick film, which is environmentally friendly, safe, and energy-efficient, extends the working life of parts, and is beginning to directly and indirectly contribute to CO_2 reduction for the prevention of global warming.

Fully automatic DLC film-formation equipment (KURITA Seisakusho Co., Ltd.)

DLC film-formation equipment for large parts
Diameter of 1.2 m, Body length to 2 m

Approaches after Completion of Project

1. Promotion of Synchrotron Radiation R&D

The high-precision X-ray microbeam equipment and other products developed as part of this project were installed at the Hyogo Beamline (BL24XU) experiment hatch at SPring-8, and have been used for other research projects in this field, even after completion of this project.
The equipment also promotes industry-academia-government projects focusing on the industrial use of synchrotron radiation in the Harima area, including construction of the new Hyogo beamline (BL08B2, which began operation in 2005), promotion of the regional joint research project (2004–2008), and construction of the Hyogo Synchrotron Radiation Nanotechnology Laboratory (established in January 2008).

Hyogo Beamline at SPring-8

High-precision parallel X-ray microbeam equipment

2. Promotion and Advancement of Plasma Arc Machining Technology

■Winner of the 2nd Japan Manufacturing Grand Prix Excellent Prize

The group consisting of Kurita Seisakusho, PLUS, University of Hyogo, and the National Institute of Advanced Industrial Science and Technology was awarded the prize for achievements in spreading DLC thick films, environmentally friendly design, safety, and energy-efficiency, for large industrial products with Plasma Based Ion Implantation & Deposition techniques and the system developed as part of this project.

■Development of Long-lived DLC Deposition Prosthetic Joints（JST：Project to develop “Innovation seeds” by universities and other public research institutes）

The simulator experiment for hip prosthesis was conducted to extend the product life by forming DLC films with low-friction abrasion characteristic on the metal bone head of the artificial hip prosthesis, and attempting to reduce abrasion of the ultrahigh-density polyethylene mortar.

■Continuation of R&D Activity with the Next-Generation DLC Technical Workshop

Ongoing research is focusing on the development of an electro-mechanical cylinder for long-term use under high surface pressure, conducted mainly by the University of Hyogo and Tsubaki Emerson Co. Findings to date have shown that DLC ultralow-friction would be possible only under limited membrane conditions and materials. In the future, after determining the necessary conditions and mechanisms, we will apply DLC with high sliding properties, ultralow friction, and long membrane life. We intend to introduce this technology into an electro-mechanical cylinder.

3. Promotion of the Technique of Low-temperature High-speed Atom Nitriding Using Electron-Beam-Excited Plasma

The high-speed atom nitriding equipment developed in this project is used for practical examinations of the nitriding process of aluminum alloy and titanium. The equipment is being used in R&D into the high-throughput nitriding equipment as part of the “Establishment of Surface Preparation Technology for Enhanced Competitiveness in the Mechanical Manufacturing Industry” project supported by The Mechanical Social Systems Foundation. A prototype machine of the atom nitriding equipment, which was in use prior to this project, has been moved to Shimizu Densetu Kogyo Co. Ltd., and is currently used for nitriding treatment on a contract basis. The development of new systems will be actively pursued in the future in conjunction with potential user enterprises.

●Basic Stage

Environment

(Fiscal Year 2002-2004)

Shinjiko and Nakaumi Area

Model of Industrial Symbiosis for a Recycling-Oriented Society
-Development of Water-Environment-Restoration Technology-

Shimane Industrial Promotion Foundation
Techno ARC Shimane, 1 Hokuryocho, Matsue City, Shimane 690-0816 JAPAN
TEL: +81-852-60-5112

Core Research Organizations
Shimane University, Matsue National College of Technology,
Shimane Institute for Industrial Technology

Major Participating Research Organizations
Industry···KANATSU. ENGINEERING Co., Ltd., Fujii consulting Engineer & associates Co., Ltd., Matsue Doken, Inc., IZCON Co., Ltd., IZUMO DOKEN Co., Ltd., Mishima Co., Ltd., SAN-IN KENSETSU KOGYO Co., Ltd., Komatsuelectric Industry Co., Ltd.
Academia···Shimane University, Matsue National College of Technology
Government···Ministry of Land, Infrastructure and Transport Chugoku Regional Development Bureau Izumo River Office, Shimane Institute for Industrial Technology, Shimane Prefectural Institute of Public Health and Environment Science, Shimane Prefectural Inland Fisheries Experimental Station

Main Results of City Area Program

1. Success in Developing P-CON, a High-Performance Phosphorus-Adsorbing Concrete

P-CON, a material designed for restoration of the aqueous environment, incorporates the phosphorus-adsorbing hydrotalcite (HT) and a special buoyant body concrete. If used with waterside plants such as Yoshi, P-CON facilitates the growth of plants by providing them with phosphorus uptake from the water. Small island-type samples of P-CON are being trialed in Muchi-no Ike Pond in Shinjuku-ku, Tokyo, large island-type samples with plants are being trialed in Hube Dam, Shimane, and underwater-type samples with Yoshi plants are being tested in Lake Shinjiko.


Ex. 1. Trial installation of floating-type samples of P-CON

2. Determining the Agricultural Availability of Residue Remaining after Decomposition

We formed a committee to study recycling of the residue remaining after decomposition in agriculture areas in Higashiizumo Town, an important production center for cabbage. The committee conducted cultivation experiments, applying the residue as fertilizer in Iya district of Nakaumi reclaimed land in Higashiizumo Town. The results indicate that cabbage yields on the test plots are equivalent to those in areas treated with chemical fertilizer. Based on the results, the committee developed usage standards to ensure safe use and improved crop quality.


Ex. 2. Test cultivation undertaken to assess the availability of residue remaining after decomposition in an agricultural field, Nakaumi reclaimed land

Approaches after Completion of Project

Proposal and Adoption by the Regional Regeneration Consortium R&D Program of the Ministry of Economy, Trade and Industry

■Proposed project: “Development of batch-processing system for mixed liquid–solid waste”

We developed a batch-processing system for mixed liquid–solid waste by combining the original technology developed by Matsue Doken, Inc. with that of Mishima Co., Ltd. and the research achievements of this project. The system enables the complete treatment and recycling of high-water-content organic waste discharged from a livestock breeder or a food-processing factory, such as livestock excreta and food residue.


Ex. 3. Fermentative treatment unit for organic sludge, as developed by Mishima Co., Ltd

■Proposed project: “Development of a high-performance phosphorus removal and recovery plant for medium- and small-scale wastewater treatment facilities”

We succeeded in developing a phosphorus-removal plant with a capacity equal to that of large-scale wastewater treatment facilities and maintenance requirements equal to those of medium- and small-scale wastewater treatment facilities. We also succeeded in developing a phosphorus-recovery plant and HTCF-regeneration plant. These successes bring together (1) the technological seed of hydrotalcite (HT), which is a practical adsorbent with high selectivity and a large adsorption capacity for phosphate ions, as developed by Shimane University; (2) the business record of Izcon Co., Ltd in terms of medium- and small-scale wastewater treatment facilities; (3) the fiber carrying technology (HTCF: HT Carrying Fiber) of Teijin Engineering Co., Ltd; and (4) the design technology of Clion Co., Ltd in terms of water treatment facilities.


Ex. 4. Phosphorus-removal plant


Ex. 5. HTCF-regeneration plant and phosphorus-recovery plant

●Basic Stage

Others

(Fiscal Year 2002-2004)

Western Okayama Area

Establishment of Ultra-Precision and Ultrafine Processing Technology for Machining Accelerator Cells and Other Applications

Okayama Prefecture Industrial Promotion Foundation
Techno Support Okayama, 5301 Haga, Okayama City, Okayama 701-1221 JAPAN
TEL: +81-86-286-9651

Core Research Organization
Industrial Technology Center of Okayama Prefecture

Major Participating Research Organizations
Industry···YASDA PRECISION TOOLS K.K., Kasen Nozzle Mfg. Co., Ltd.
Academia···Okayama University, Okayama University of Science, University of Tokyo Institute for Cosmic Ray Research
Government···Industrial Technology Center of Okayama Prefecture, High Energy Accelerator Research Organization (KEK)

Main Results of City Area Program

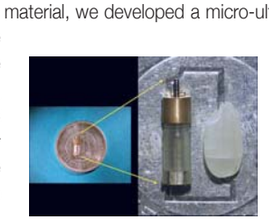
1. Development of an ultra-precision lathe with high accuracy and efficiency

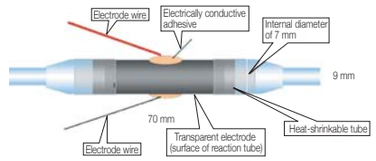
For machining both sides of workpieces using an ultra-precision lathe, it is necessary to remove the workpiece from the chuck and remount it on the other side; however, this re-mounting process commonly results in a reduction in machining accuracy and efficiency.
In this project, we developed a hollow spindle to enable the machining of both sides of the workpiece with a single chucking action, and an ultra-precision lathe incorporating the spindle. The new products enable high accuracy and high efficiency in machining both sides of workpieces such as “Accelerator Cells.”


Hollow spindle on an ultra-precision lathe

2. Development of micromachining technology for producing microreactors and microactuators

Microreactors are devices in which chemical reactions are initiated in a micro-space ranging in size from several microns to several millimeters. In this project, many microreactors and microactuators were developed for this purpose. For instance, using a cylindrical piezoelectric device fabricated from bulk piezoelectric material, we developed a micro-ultrasonic motor of 1.8 mm in external diameter and 5.8 mm in height. This ultrasonic motor is the smallest if its kind in the world. As a result, we achieved a starting torque of 1.6 mNm and a rotating speed of 2800 rpm with an applied voltage of 25 Vp-p. We also developed a trial active catalyst reactor with superior reaction efficiency and a simple structure, using a stirring mechanism to make the catalyst particles move by static electricity.


Micro-ultrasonic motor



Active catalytic reactor

Approaches after Completion of Project

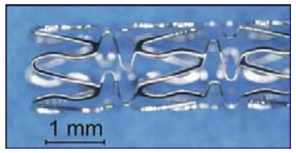
1. Promotion of active microreactor development that applies micromachining technology

The “Okayama Micro-Manufacturing Business Creation Project” is promoted by Okayama Prefecture with the aim of upgrading engineering technologies in the prefecture. In 2005, the City Area Program (Development Stage) was launched as a leading project of the “Okayama Micro-Manufacturing Project.” The theme of this project is “Development of an Active Microreactor for Progressive Micro-Reacting Process.” That is, a high-performance “Active Microreactor” is created by combining the chemical process with microactuator technology based on ultra-precision machining technology that exists in the region.
The trial manufacture and the development of various active devices that the microreactors including those peripherals based on needs-seeds of the chemical related was carried out.


Example of micro-reactor

2. Promotion of medical-device development applied in the field of high-precision manufacturing technology

The ultra-precision manufacturing technology developed as part of the City Area Program (Basic Stage) is currently being applied to the development of medical devices that enhance QOL (quality of life). The lifetime of artificial hip joints is generally 10-20 years, yet a longer lifetime is required. To this end, a high-precision machining technology, using an ultra-precision lathe, is under development. Using micro-laser machining technology, we developed a medical device (a stent) used in treating angina pectoris. These projects were conducted as part of the Okayama Micro-Manufacturing Project with the aim of promoting industry-academia-government cooperation in the Okayama area.



Stent for angina pectoris treatment

●Basic Stage

(Fiscal Year 2002-2004)

Kagoshima City Area

Function Verification of Local Agriculture and Livestock Products, and Application to Safe and Healthy Food

Life Sciences

Kagoshima Industry Support Center
Kagoshima University Innovation Center 1F, 1-21-40 Korimoto, Kagoshima City, Kagoshima 890-0065 JAPAN
TEL: +81-99-214-4770

Core Research Organization
Kagoshima University

Major Participating Research Organizations
Industry···NIHON STARCH CO.,LTD., BioMedical Technology Hybrid, Ltd., Satsuma Shuzo Co., Ltd., SHIN NIPPON BIOMEDICAL LABORATORIES, LTD., SNOW BRAND MILK PRODUCTS CO., LTD.
Academia···Kagoshima University
Government···Kagoshima Prefectural Institute of Industrial Technology

Main Results of City Area Program

1. Development of functional food that promotes human health and well-being

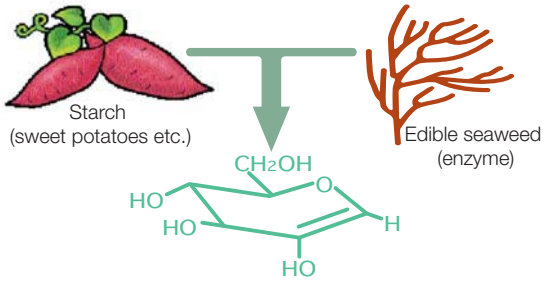
The applications of 1,5-anhydorfructose (1,5-AF) in the food market were developed in conjunction with customers. In particular, we sought to commercialize antioxidative activity, one of the important functions of 1,5-AF. Our research demonstrated that 1,5-AF has potential as an antioxidant for the food industry.

2. Development of an industrial process for 1,5-AF production

The development of an industrial process for 1,5-AF production has already reached the final stages. The effectiveness of the production equipment was assessed this year. To improve the procedure of 1,5-AF production, all processes were checked repeatedly.

We have developed the preparation methods required for the small-scale production of high-purity 1,5-AF samples. We successfully obtained high-purity 1,5-AF samples from pilot-plant-scale production, as well as small-scale preparation. Techniques for the powderization of 1,5-AF syrup were examined on a pilot scale.

Overview of 1,5-anhydrofructose



1,5-anhydrofructose (1,5-AF)

Multi-functional materials
antibacterial, antioxidative, health-promotion effect

Approaches after Completion of Project

Since our original project proposal, the production of 1,5-AF as a safe and secure anti-bacterial agent has been adopted as a Regional Consortium Research and Development Project by the Ministry of Economy, Trade and Industry. Following the completion of this research project, a new business based on the project outcomes was started in 2007. The function of 1,5-AF has been accepted by customers in test sales. The product was marketed to limited customers in 2008, and sales of 1,5-AF this year are expected to reach 10 million yen. Next year, the potential markets for a 1,5-AF business will be developed for the final market assessment, and the business scale of the second stage will be defined based on the assessment. When the business enters the second stage, the 1,5-AF product will be promoted to many customers world-wide.

Product