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Ultimate in Vacuum

ULVAC

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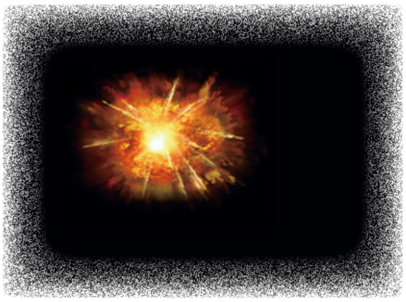
No. 67

ULVAC

contents



Cover Photo:
"Moss phlox in Chichibu-city, Saitama Prefecture, Japan"
Photographed by:
Ryoichi Kobayashi, Quality assurance department, ULVAC COATING CORPORATION

"The bloom period of moss phlox is around 3 weeks, but the full bloom period is shorter. During the full bloom period, there is a few sunny days that we can see moss phlox clearly. In that condition, I was able to get the precious photo."

PICTURES:
p.4-5, 7, 9 Metal Technology Co. Ltd.
p.10-13 Nissei Company, Ltd.
p.15-18 KEK

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Developing "the metal solution" Through Daring Capital Investments and Technological Developments

—— The springboard to development was the introduction of vacuum heat treatment furnaces, HIP, and machining equipment

Interviewer: **Hisaharu Obinata**
Chairman*, ULVAC, Inc.

Guest: **Mr. Kazuhiko Hasegawa**
President, Metal Technology Co. Ltd.

Metal Technology Co. Ltd. was established in 1960 as a pioneer in the metal heat treatment industry. Since then the company has made numerous technological breakthroughs and, under the slogan "the metal solution," it now possesses a diverse range of processing technologies, including metal heat treatment, hot isostatic pressing (HIP), sintering, bonding, welding, superplastic forming, additive manufacturing, analysis, and machining. By combining these outstanding technologies, the company is developing its business as one of the world's leading manufacturers specializing in metal processing. By bringing the industry's leading cutting-edge technologies to the forefront, Metal Technology is contributing to the industry through its advanced metal processing technologies in a wide variety of industrial sectors, from liquid crystal displays and semiconductor fabrication to aerospace development. The driving force behind its sustained growth is its approach of anticipating advanced needs and working proactively to open up new growth markets. For this "Executive Guest" section, we invited Mr. Kazuhiko Hasegawa, President of Metal Technology Co. Ltd., to discuss, among other things, how the company has grown, its aims for the future, and what areas of growth it expects in the future.

***As of July 1, 2017**

Vertical single-chamber vacuum furnace (Japan's largest)

Aircraft component

Giga-HIP
(The world's largest)

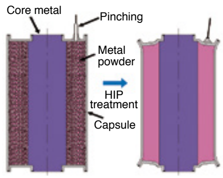
Powder metal sintering using a hot press

500-ton single-axis hot press

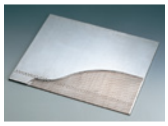
Horizontal single-chamber vacuum furnace

Horizontal three-chamber vacuum furnace

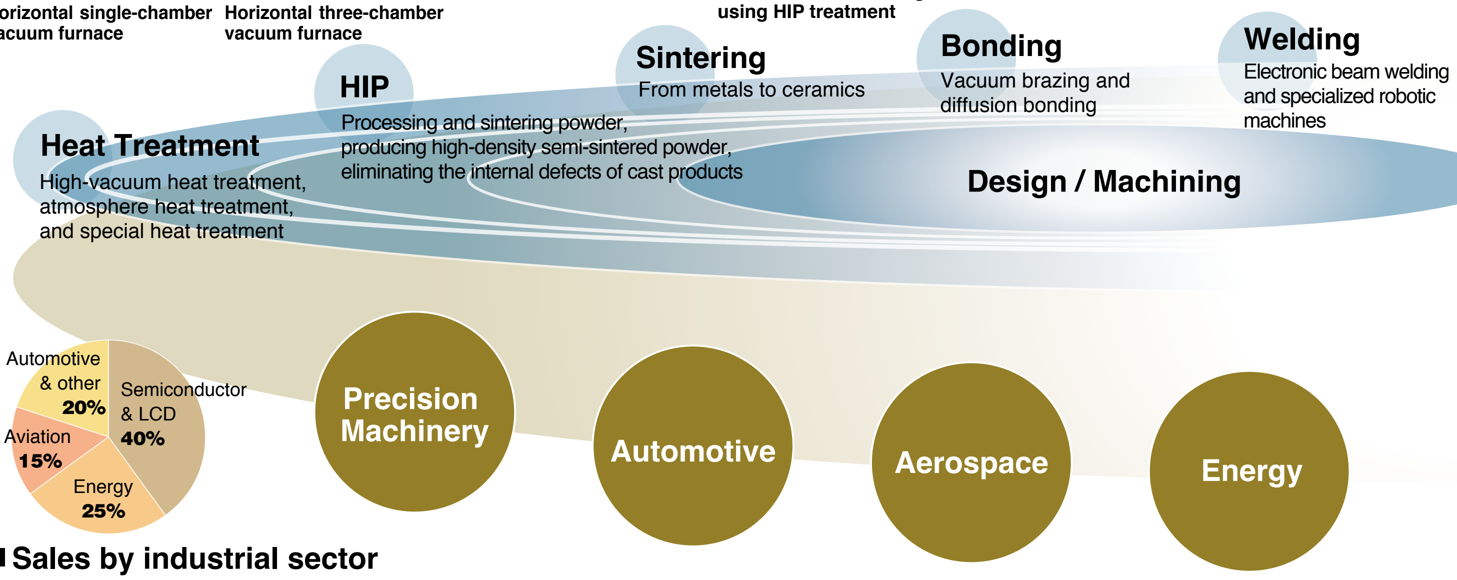
Bonded samples of dissimilar materials



Powder metal sintering using HIP treatment



A heat exchanger plate



■ Sales by industrial sector

First turning point: The installation of an ULVAC vacuum heat treatment furnace

Obinata: You have been using ULVAC vacuum heat treatment furnaces for a long time. I was also pleased to hear that you have decided to install a new vacuum heat treatment furnace at your Toki Plant, which is scheduled to start operation in the fall of this year.

I have been looking forward to today's interview and I have a lot of questions that I would like to ask you. One is how our vacuum heat treatment furnaces contribute to your success, and another is what type of vacuum heat treatment furnace you would like to see developed in the future. Dr. Kazuya Saito, Executive Officer and Manager of ULVAC's Research & Development Planning Department, will also be joining us for this interview.

First of all, could you tell us a little about how Metal Technology was established, how it has grown, and what its current organizational structure is?

Hasegawa: There have been several turning points over the past 57 years.

Let me start with a brief description of the company's history. Metal Technology was founded in 1960 by a number of researchers who were then working at the Institute of Physical and Chemical Research (Riken). As Riken was being relocated that year from Komagome in Tokyo's Toshima Ward to Wako City, Saitama Prefecture, several of its researchers decided to create a spin-off group that founded Metal Technology with the aim of validating research results in the industrial world.

Riken researchers had conducted research into titanium and heat treatment for magnetic materials, but the latter quickly led to business opportunities for Metal Technology.

When the company was first established, it began carrying out heat treatment for metal components in a hydrogen gas atmosphere as well as vacuum brazing. However, in 1970 we installed ULVAC's FHH-45L vacuum heat treatment furnace and acquired certification from Japan's then Defense Agency (now the Ministry of Defense) and entered the modern heat treatment business in earnest. This was our first turning point.

Obinata: I heard that our plant manager at the time, Mr. Takei, was involved in the installation of your vacuum heat treatment furnace. In those days, he was considering the development of a new vacuum heat treatment furnace. As Metal Technology intended to enter the aircraft sector, it had been planning to install a vacuum heat treatment furnace rather than an ordinary atmosphere furnace, but the high cost of such a furnace had caused the company to waver. At that point, Mr. Takei visited Metal Technology and offered that we develop a new vacuum heat treatment furnace jointly with you. Metal Technology readily agreed to this offer. Ever since then, ULVAC has enjoyed a close working relationship with Metal Technology.

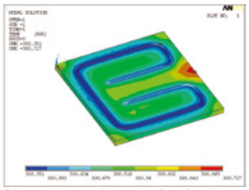
Hasegawa: At that time, Japan had just started repairing aircraft engines. New materials were beginning to appear, but there was a limit to the capabilities of atmosphere furnaces. That was why we considered installing a vacuum heat treatment furnace.

Obinata: It was due to this that ULVAC became involved in developing cutting-edge vacuum heat treatment furnaces, so I'm glad you made the decision you did.

EXECUTIVE GUEST


Hot-forming machine


Direct metal laser sintering


Heat transfer analysis for aluminum alloy

ISO 9000 Series

ISO 14000 Series

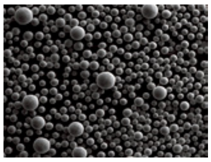
Nadcap

(International certification system for special processes)

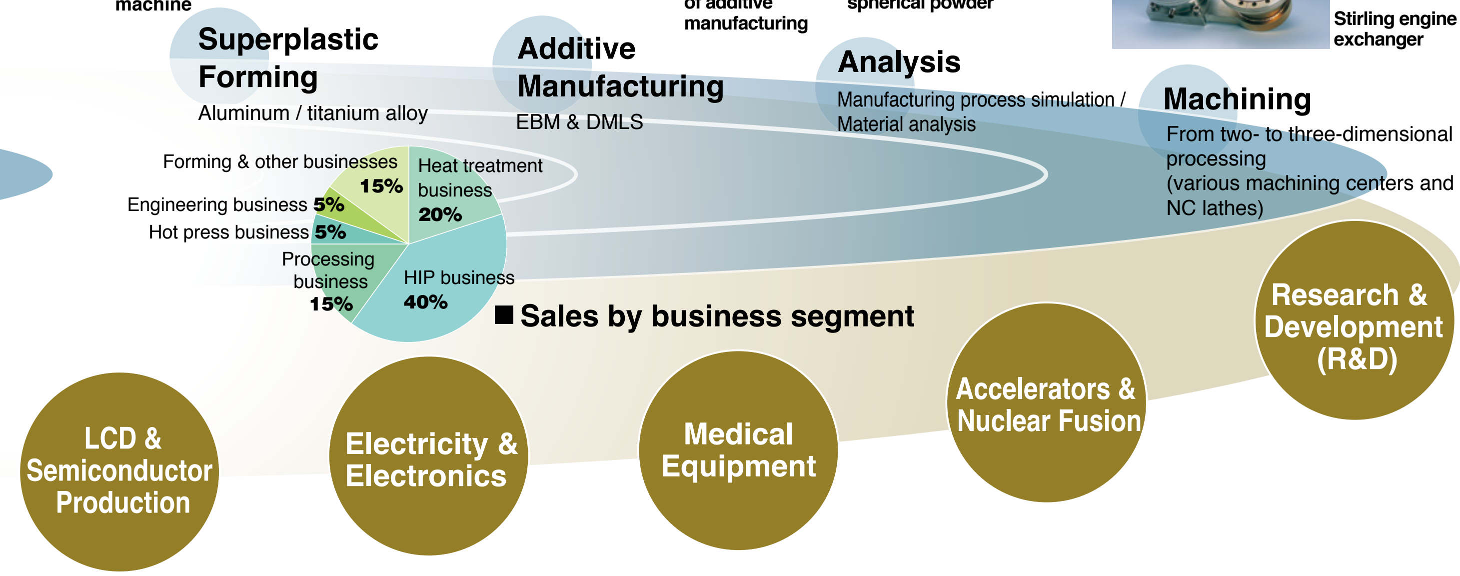

Superplastic forming machine


Electron beam melting


Examples of additive manufacturing


Rapidly solidified spherical powder


Stirling engine heat exchanger



■ Sales by business segment

Second and third turning points: The introduction of HIP and machining

Hasegawa: The second turning point for our company was the launch of the hot isostatic pressing (HIP) business. The HIP process facilitates the sintering of powder metal materials, the removal of defects from inside a casting, and the use of diffusion bonding by increasing the pressure of argon gas to 1,000 atm or more and containing it within the furnace at a high temperature. The most attractive aspect of this process is that it allows us to apply sintering technologies in the development of new materials that meet our objectives.

Since installing its first HIP equipment in 1984, Metal Technology has developed its HIP business with a focus on increasing the density of cast and sintered products. We now have a total of 18 HIP machines, including those installed at our Chinese subsidiary. We choose which of the various machines to use based on the needs of the customer.

The third turning point was the commencement of machining.

In 1990, Metal Technology began machining in earnest for the first time. As a late comer to this line of business, we needed to differentiate our company from our competitors, so we choose to start a business specializing in a hard but viscous nickel-based alloy called Hastelloy. Even though we were new to this field, we were able to succeed for two reasons: the first reason being that it is easier for a heat treatment business to enter the machining industry than it is for a machining business to enter the heat treatment industry, and the second being that our entry into this industry helped improve the way clients, particularly those in the aircraft industry, placed orders by eliminating the need for "zigzag orders"*.

As a result, Metal Technology is now involved in six major business segments: metal heat treatment (the company's original line of business), HIP, hot press, machining, forming, and engineering.

These businesses are underpinned by technologies for the following types of processing work: heat treatment control; brazing; diffusion bonding and sintering through the use of vacuum hot presses and HIP equipment; superplastic forming (SPF); welding assembly through the extensive use of electron beam welding (EBW) and robotics; processing through the use of large machining centers; surface processing through the extensive use of various thermal spraying systems; and additive manufacturing.

Evolving like a living creature metal processing requires not only equipment but also engineering know-how

Obinata: As metal processing is Metal Technology's core technology, could you explain what makes metal processing technologies appealing or interesting and tell us a little about the difficulties involved?

Hasegawa: At first glance, metal may appear to be just a cold, hard object, but it transforms when heated, cooled, or pressurized. Also, with each type of metal having clearly defined properties, the way a particular type of metal changes when processed can be established.

Nonetheless, even if metal is processed in the same way using the same furnace, a completely different change can be observed if the processing conditions vary even slightly.

Changes in the way a piece of metal is polished can significantly affect its bonding properties and the slightest

* A "zigzag order" is a form of transaction in which a component goes back and forth between the client and its contractors (mainly small and medium-sized enterprises) as it proceeds through each of the production processes. Since the aerospace industry in particular requires strict certification, it is difficult to adopt an integrated production system and the order placement, product delivery, and product acceptance processes tend to be inefficient because they all require time and labor. This results in higher costs and a longer lead time for delivery.

error in the calculation of its predicted expansion or contraction can change its form considerably. Although metal is clearly a material object, it exhibits changes or possesses different properties as if it were a living creature. This is why we not only need equipment but also engineering know-how as well.

Saito: You have the world's highest processing capacity in terms of HIP, as well. How did you first become interested in this area?

Hasegawa: HIP was already being used in the field of super hard materials for products such as cutting tools, but it was manufacturers that were using it. Metal Technology may have been the first company to introduce HIP as part of its processing services. At first, we had a few doubts about its potential, but when we tried using HIP with powder materials, the results were far better than we had anticipated. HIP allowed us to achieve things that would not have been possible with melting. We firmly believed that this was a technology that would change the world.

In fact, almost all devices—from mobile phones to large TV sets, semiconductors, and electronic components—have been reduced in size and weight. Many of these devices benefit from HIP technology as it enables manufacturers to produce goods by solidifying powder materials.

Saito: You experienced the potential of HIP first hand, didn't you?

Hasegawa: "Change" is necessary—not only in the narrow field of metal processing technologies but in all other fields as well—because modifying the shape of something or improving the performance of a device, for example, can make the previously impossible become possible today. Companies constantly evolve and develop by doing this repeatedly, which can be an extremely interesting experience for the people involved in this process. This not only improves how we go about meeting our customers' demands and expectations, but also helps us to develop large-scale projects that make the most of these technologies. Our engineering business unit operates in precisely that world. It is constantly taking on new challenges.

Obinata: What is your engineering division involved in?

Hasegawa: It's involved in what might be described as 'national projects.'

For example, our accelerator project team is conducting research into technology that utilizes neutrons for various purposes such as cancer treatment. We are also participating in a project to develop a type of atomic fusion laboratory equipment called 'artificial sun' with the aim of developing technologies to be utilized as future energy sources. This initiative is completely different to anything we have done in the past. Our previous projects have been customer led but in our engineering business, to a certain extent, we prioritize our own way of thinking.

Furthermore, as we have gained experience in the jet engine repair business which we launched about five years ago, we have found that it requires a level of stringency that is considerably different from our first impressions because passengers' lives depend on the quality of such work. In this line of business, we require overseas certification from regulators such as the U.S. Federal Aviation Administration (FAA) and the European Aviation Safety Agency (EASA). For a small or medium-sized Japanese enterprise like us to have entered this line of business is unprecedented, so the industry is carefully monitoring our performance.

Realizing a 30-year ambition by establishing a new plant in Toki, Gifu Prefecture

Obinata: Could you give us a brief description of your Toki Plant in Gifu Prefecture, which is scheduled to start operation soon, and tell us what your expectations for the plant are?

Hasegawa: Aircraft manufacturers have asked us if we could increase our production as they are in the process of transitioning from previous models to new ones. We have no room for expansion at the Shiga Plant, which is responsible for handling orders from these manufacturers, so we needed to secure a new plant site to further expand our facilities. Given this, we decided to expand into the Chubu region, a key market in the aviation industry that is located close to our customers. Expanding into the Chubu region is actually the realization of an ambition that Metal Technology has had for about 30 years. A variety of conditions had to be met for Metal Technology to reach where it is today.

What makes the Toki Plant different is that it was designed with the aim of building a plant based on the concept of streamlining operations to pursue labor savings and personnel reductions. Naturally, we are looking to develop our business with the global market in mind.

Obinata: The Toki Plant is being built to serve the aerospace industry, isn't it? Up to now, ULVAC's heat treatment furnaces have generally been used in automobile-related industries, but we will endeavor to develop them for the aircraft industry as well. Going forward, what will the requirements for vacuum heat treatment furnaces be in the aircraft industry?

Hasegawa: One benefit of ULVAC's vacuum heat treatment furnace business is that it supplies multi-chamber vacuum heat treatment furnaces that deliver high productivity, but we are keenly aware that it is difficult to measure substance temperatures during heat treatment processing.

In the aviation sector, it is sometimes necessary to measure substance temperatures as a key part of quality assurance, so we need a method or system that will enable us to measure substance temperatures while the products being treated move from one chamber to another. The other day, we received an innovative proposal from ULVAC. If this can be developed to cater to the needs of the aviation industry and you can obtain the approval of a certification body, the proposal will have tremendous potential. We look forward to this—if you succeed in this, it will bring about a revolution!

Constantly reevaluating our company's perspectives! Overdependence ruins a company

Obinata: You said that the ability to measure substance temperatures in a multi-chamber vacuum heat treatment furnace would be a revolutionary development—these are very encouraging words! In its management policy, Metal Technology states that it will work constantly to anticipate changes, provide numerous solutions, attempt to deliver technological innovation perpetually, and further increase its potential. In line with the spirit inherited from the company's founders, you are developing new products with a view to future developments. Can you tell us about the structure and creative ideas that you employ to accumulate know-how and develop new processes?

Hasegawa: What we learnt from our predecessors was the need for active capital investment, but that doesn't necessarily mean that equipment must always come first. When the objective of introducing new equipment is clear and it is necessary as a source of income in the future, we introduce it early on by adding our own specifications and making improvements to it.

Saito: You mentioned that you introduce new equipment early on if it will become a source of income in the future, but this can be difficult to judge. Actually, HIP sintering is what you might describe as a "source of income," so what criteria did you use to make the decision to adopt this technology?

Hasegawa: The liquid crystal display market was the original trigger for our introduction of HIP, but we ended up using it for aircraft, particularly for turbine cases and compressors. With engines now becoming smaller and lighter, our targets are shifting but we are still operating at full capacity.

In any case, it is important how equipment is used. Where small and medium-sized enterprises like us have an advantage is our agility and adaptability. Due to the ongoing globalization, there are no longer any barriers between large and small businesses and there is no longer a tendency for large corporations to take care of their contractors like they did in good old days. What a difficult time we live in!

Given this, agile small and medium-sized enterprises that are capable of making swift decisions must always stay ahead of the competition, and if they are overtaken, they must take the next step. Otherwise, they will be beaten. I do not mean this as a criticism of large corporations at all. I simply mean that we now live in an extremely challenging world and that small and medium-sized enterprises need to change their management setup as well. Overdependence will ruin a company.

Obinata: You made a considerable investment in HIP, didn't you?

Hasegawa: Many objected to the adoption of HIP, but I gave my approval and introduced it resolutely. Our investment totaled about six billion yen, and if I may exaggerate a little, that amount was close to our total annual sales at the time.

Obinata: That's amazing. We worry about making investments even if they represent only 10% of our annual sales [laughs].

You are known to believe that the more hardships you undergo, the greater the results you will achieve and I totally agree with you. My opinion is that the more energy a company puts into development, the greater the benefits that will follow. Companies that save their efforts in development will neither grow nor generate any profit. First and foremost, companies need to spend money on development. How is development conducted at your company?

Hasegawa: This is a weak point of small and medium-sized enterprises— they cannot easily appropriate large budgets to projects with an uncertain outcome. In the past, we promoted development by establishing a development headquarters, but this initiative was not linked directly to our plants and it tended to focus on production technologies, so its work ended up overlapping with that of the production engineering department at our plants. As a result, we failed to get the results we were hoping for.

Our technology headquarters is responsible for development now. Plant personnel are also added to our development teams. Based on the information that our plant and sales personnel have on markets, customer needs, and future trends, we focus on two aspects in our project style: ensuring that newly developed technologies take root and advancing research and development.

Suzhou Plant in China supports the ever-expanding aircraft sector

Obinata: I understand you are growing your business in Suzhou, China, too. We are very grateful that you use the vacuum heat treatment furnaces produced by our Chinese subsidiary. Please tell us a little about your business in China.

Hasegawa: Our ULVAC vacuum heat treatment furnaces are doing a great job at our Chinese subsidiary. They meet the manufacturing requirements for aircraft specifications. As they are Nadcap-certified, we are using them in the heat treatment and vacuum brazing of components used in aircraft as well as those used in industrial equipment such as thermal power gas turbines and medical devices.

Similarly to our vacuum heat treatment furnaces, our main HIP equipment is used as a type of certified aviation furnace in the removal of defects from precision castings for components used in products such as aircraft, thermal power gas turbines, and automobiles. This has enabled Metal Technology to grow its business in China as a dedicated

Profile of Mr. Kazuhiko Hasegawa

President, Metal Technology Co. Ltd.

Mr. Hasegawa was born on August 5, 1953. Having graduated from the Hokkaido Institute of Technology with a bachelor's degree in mechanical engineering, he joined Metal Technology Co. Ltd. in 1976. He was appointed manager of the Himeji Plant in 1988, elected as a director in 1997, became director and head of the Sales Division in 1999, and then was promoted to the post of Managing Director in 2001. In 2005, he took office as president, a post he holds to this day.

Company profile

Metal Technology Co. Ltd.

- Head office: Harmony Tower 27F, 1-32-2 Honcho, Nakano-ku, Tokyo
- Establishment: February 10, 1960
- Representative: Kazuhiko Hasegawa, President
- Capital: ¥288 million
- Net sales: ¥9,460 million (2017)
- No. of employees: 521 (as of May 2017)
- Main business lines:
  (1) Heat treatment for metal components
  (2) Bonding of metals and ceramics
  (3) HIP treatment
  (4) Sintering of metals and ceramics
  (5) Electron beam welding and assembly, etc.
  (6) Superplastic forming
  (7) Additive Manufacturing
  (8) Analysis
  (9) Precision processing

Hisaharu Obinata,
Chairman, ULVAC, Inc.

Kazuya Saito,
Executive Officer and Manager of the Research & Development Planning Department, ULVAC, Inc.

contractor for special processes, such as aviation. It is four years since our Chinese subsidiary entered full-scale operation and we are confident that it will start making a profit this year.

Obinata: You mention that you're confident that, after four years of operation, your Chinese subsidiary will soon go into the black, but it actually took five years for our large equipment assembly plant in Suzhou to do so. It finally started making a profit last year.

One of the various reasons for our lack of progress was a problem with the supply chain. At first, we couldn't find a supplier capable of delivering products that met our requirements, but we worked steadily to improve our product quality. Also, to raise the capabilities of our engineers there, we had Japanese and Korean personnel visit China to train them. In fact, the greatest obstacle we faced was that Chinese customers did not trust the quality of Chinese products. They asked us to supply them with products manufactured at plants in Japan, but we obviously couldn't continue to manufacture our products in Japan forever. Given this, we actually decided to produce some large-scale equipment in China and ask our customers to check the quality. By taking this bold step, we were able to gain the confidence of our Chinese customers, who confirmed that the level of quality was acceptable. Today, our Chinese subsidiary is operating at full capacity.

Hasegawa: I'm glad to hear that. ULVAC is now better known in China, and we have great hopes for the future of your company.

Demand for aircraft is expected to continue to grow around the world, particularly in China. As the intentions of the Chinese government are consistent with those of foreign-affiliated companies, Western manufacturers are expanding their local production through joint ventures.

Given the degree of technological growth and costs involved in such joint ventures, China is suddenly attracting a lot of attention. However, the quality and reliability of special processes are a separate matter, and there aren't really any local companies that can be relied upon in this sector. Even if such a company were to be established, it would not be able to achieve the quality we demand overnight. The level of quality needed to meet the requirements for aircraft can be trusted in other industries too, so such a level would also meet the needs of many customers in other sectors.

Obinata: What are the main difference between China and Japan? Have you experienced any difficulties in China?

Hasegawa: Similar to a laundry, we receive articles from our Chinese customers and then return them after we have processed them there in China. As a result, we have to solve any problems locally. Also, in China, there are almost no Japanese-affiliated companies producing high-value-added products that require HIP, so we couldn't rely on business rights brought over from Japan or on receiving work from the Japanese-affiliated companies that we deal with in Japan. Consequently, we had no choice but to raise the technological capabilities of our Chinese subsidiary.

Half of the current site for the Suzhou Plant is still vacant. As well as working to ensure that we can meet aircraft and power generation-related demand going forward, members of our Chinese subsidiary are also proactively seeking to secure sales in engineering and other fields and requesting additional equipment.

All acts lead to "the metal solution"

Obinata: You became president of Metal Technology in 2005. In this management role what do you endeavor to achieve? Also, please tell us your views on personnel training.

Hasegawa: We are proactive in addressing environmental issues. In a sense, our guiding principle of considering both the environment and people as important means much the same thing as saying that the environment and people are closely interrelated. The word "environment" basically means not only the Earth itself, but also society, workplaces, and people's lives. Essentially, people are involved in all of these, and recently there has been a shift to people wanting a comfortable place to live and spend time in rather than just convenience. We may not be able to achieve anything significant immediately but, as a responsible member of society, we are trying to begin by focusing on the small things that we can do. Since Metal Technology was established as a heat treatment business, its work environment is less favorable than that of other industries. With most of our plants having acquired ISO 14001 certification, we keep in mind the need to create a workplace and environment in which our employees can work comfortably and aim to undertake measures that will lead to the company developing further. It is people that can ensure that this goal is achieved as planned, so they will play a key role in this.

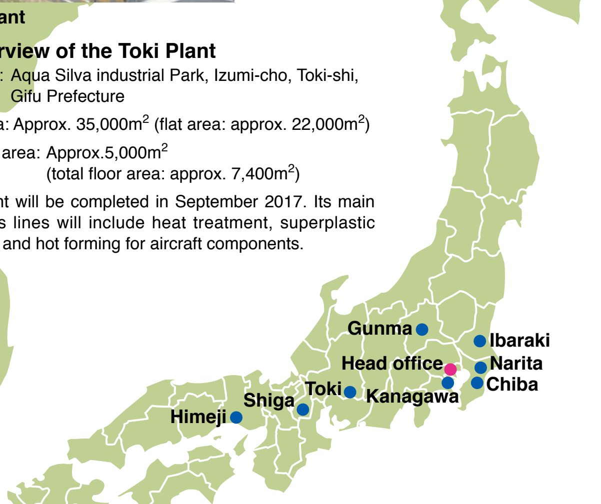
Obinata: People are the most important aspect of all management resources.

Hasegawa: As I have said both inside and outside our company ever since I took office as president, people are, as you say, an important factor. Given this, I have continued to this very day to run the company under the slogan "A company is its people—they are its most valuable assets." This will not change in the future. You can obtain whatever equipment you want if you pay for it, but this is not the case with people. You need to hire people who have high aspirations and then train and develop them.

At orientation meetings and interviews for prospective employees, when I talk about matters such as the technologies we possess, our main lines of business, our aims, and my enthusiasm for management, many of the students respond favorably to what I am saying. Ideally, we want to employ students who feel a connection with Metal Technology's guiding principles. In this way, we are striving to ensure that Metal Technology remains an attractive company with "shared values" as its keyword.

We emphasize "growth" over "expansion". In other words, we strive to achieve what we have been unable to do so far. This means that we constantly improve what we do and that we run the company based on the enthusiasm of each and every one of our employees.

■ Offices & plants




Shiga Plant


Toki Plant

Overview of the Toki Plant

Address: Aqua Silva industrial Park, Izumi-cho, Toki-shi, Gifu Prefecture

Site area: Approx. 35,000m^2 (flat area: approx. 22,000m^2)

Building area: Approx.5,000m^2 (total floor area: approx. 7,400m^2)

The plant will be completed in September 2017. Its main business lines will include heat treatment, superplastic forming, and hot forming for aircraft components.


Himeji Plant


Gunma Plant


Ibaraki Plant


Narita Plant


Metal Technology (Suzhou) Co. Ltd.


Kanagawa Plant
Technical Center


Chiba Plant

We also keep diversity in mind at all times, of course. We have no intention of putting up barriers due to cultural differences, in fact, we actively seek to hire foreigners, a practice that is rarely seen in Japanese companies, to promote women to managerial posts, and to assign engineers to our sales departments. We manage the company based on the belief that all of our current efforts will lead to "the metal solution."

Obinata: Engineers and researchers came together to establish Metal Technology out of their desire to help the world through heat treatment technologies. ULVAC was also founded by young engineers who wished to help support postwar industrial reconstruction through the use of vacuum technologies. Just as you have adopted the slogan "the metal solution," we have adopted the motto "ULVAC solution" to help contribute to society through our comprehensive vacuum technologies. A company is a public entity of society. Our intention is to ensure our company's future by helping society rather than simply pursuing profits. Five years have passed since I took the helm at ULVAC, and our top priorities are people's safety, consideration for the local community's environment, and product and service quality. I have told our employees that if they address these three priorities appropriately, profits will follow automatically. I want us to do a good job sincerely and properly. This is the driving force behind our company as an ongoing concern. To that end, I share your opinion, Mr. Hasegawa, that the emphasis should be placed on people.

Adopting new equipment based on vacuum heat treatment furnace technologies

Obinata: Do you have any requests for ULVAC?

Hasegawa: As I mentioned earlier, ever since Metal Technology first purchased a vacuum heat treatment furnace from ULVAC in 1970, it has continued to install ULVAC's industrial vacuum heat treatment furnaces in large numbers.

Furthermore, when we installed some additional furnaces, you met the requests of our field managers and offered furnaces tailored to our original specifications. This enabled us to establish a strong position as a company specializing in vacuum heat treatment and vacuum brazing in Japan.

Also, we are now concentrating on vacuum diffusion bonding and sintering technology. In order to advance these areas, we need even more innovative equipment that employs vacuum technology. Since these businesses are based on vacuum heat treatment technology, we believe that we can make full use of ULVAC's technologies in these sectors. We have great hopes for your technology.

Obinata: In the course of this interview, I have come to realize that our vacuum heat treatment furnaces have been of great use to you and I am very proud of our contribution to your success. Going forward, I hope that you will give us the benefit of your advice as we continue with our efforts to develop vacuum heat treatment furnaces and applied vacuum equipment that will live up to your expectations.

Obinata and Saito: Thank you for joining us today.

Connecting the World Through “Soft” Communication

—— Providing cheerful smiles and a healthy food culture to people across generations and boundaries

Nissei Company, Ltd. (Head office: Ibaraki City, Osaka)

Nissei continues to evolve, making the world of dessert foods richer and more diverse

Nissei creates a world full of soft serve ice cream and other dessert foods. Staying true to its belief that delicious foods bring Japan together with the rest of the world, Nissei has continued to develop foods that meet the needs of the times by using technologies and information gathered from around the world.

This initiative has enabled us to create new products and to continue exploring new frontiers even to this day.

LIVING & ULVAC

Allow me to start with a question: Do you like sweet foods? On what occasions do you eat soft serve ice cream? When Nissei—a comprehensive soft serve ice cream manufacturer that is celebrating its 70th anniversary this year—conducted a questionnaire survey, it was apparent from the results that soft serve ice cream always brings a smile to consumers' faces. Ever since its foundation, the company has remained committed to its mission of helping to revitalize post-war Japan, bring a new culture of comfort to the Japanese people and establish a line of communication with its customers by delivering soft serve ice cream fresh from the machine. For this issue's "Living and ULVAC," we visited Nissei's Tokyo Office (Shinagawa-ku, Tokyo) to interview Mr. Koji Barada, one of Nissei's operating officers.

Mr. **Koji Barada**
Operating Officer, Nissei Company, Ltd.

Freshness is the key
The surprising origin of soft serve ice cream
The idea for ice cream cones came from waffles

The term "softcream" was coined by George Tanaka, the founder of Nissei. The correct English term is "soft serve ice cream."

With its origins in China, the method for making milk sherbet was brought to Europe via the Silk Road before making its way to the United States. Some say that soft serve ice cream first appeared in its present form in 1904, when an ice cream store and a waffle store were exhibiting their products in booths next to each other at the St. Louis World Trade Fair. In those days, ice cream was usually sold on paper plates. However, with visitors swarming to buy ice cream to ward off the summer heat, the ice cream store soon ran out of paper plates. As a result, the ice cream vendor bought some waffles from the next-door waffle store to make them into cones, and this subsequently became a common style of serving ice cream. In other words, the idea for ice cream cones came from waffles.

Automatic soft serve machines were developed in the United States thanks to a desire to serve ice cream fresh from the machine as well as to the development of freezing technology. Made by mixing the ingredients in a specially designed machine that is also known as a freezer, soft serve ice cream also contains air, which contributes to its smooth melting texture. The temperature of soft serve ice cream is approximately minus 5°C. In contrast, hard ice cream is made by rapidly hardening a soft paste at a temperature of below minus 30°C and then sold in stores at a temperature of below minus 18°C. The biggest difference between soft serve ice cream and hard-frozen ice cream is that the former is served fresh from the machine.

Soft serve ice cream was launched in Japan in 1951
July 3 is Soft Serve Ice Cream Day

In 1947, a second-generation Japanese American called George Tanaka founded Nissei Shokai Co., Ltd. , which later became the present-day Nissei. Learning about soft serve ice cream from American soldiers, Tanaka purchased 10 freezers from the United States to begin selling soft serve ice cream in Japan. First served in Japan at an American Independence Day event held in Jingu Gaien on July 3, 1951, soft serve ice cream quickly became popular in Japan. Initially, it was sold in department stores and at coffee shops for 50 yen. Given that a bowl of noodles cost 15 yen at that time, soft serve ice cream was a considerable luxury. Shortly after, Japan's first soft serve ice cream boom started, partly due to a scene in Roman Holiday—a movie that hit Japanese movie theaters in 1954—in which the protagonist, Audrey Hepburn, ate gelato on the Spanish Steps in Rome.

At first, Nissei imported cones, but the company later opened a factory in Osaka to start manufacturing its own cones. In 1963, Nissei also started the domestic freezers, and launched the production of soft serve mix, the ingredient used to manufacture soft serve ice cream. The second soft serve ice cream boom began in 1970, when soft serve ice cream was a big hit at the Osaka World Trade Fair.

In 1990, July 3 was designated as Softcream Day to commemorate the first soft serve ice cream in Japan.

How soft serve ice cream is made ULVAC technologies used in freezers and cones

When an order is received, soft serve ice cream is dispensed directly from a freezer into a cone cup to be served fresh from the machine. Figure 1 shows how soft serve ice cream is made in a freezer. First, a mixture of the raw ingredients is placed in a tank. After that, the mixture is cooled by passing a refrigerant gas that has been pressurized with a compressor through a water condenser so that it changes into a liquid. The material mixing chamber is cooled by making use of the properties of a liquefied refrigerant gas, which becomes cold when it is returns to its gas form by being sprayed at high speed. As air is incorporated in it as it is stirred, the mixture has a smooth texture when served on a cone. Finally, the refrigerant gas returns to the compressor. Under a different setting mode, the refrigerant gas can also be used to heat-sterilize the freezers every day in stores. Nissei's freezers are designed so that the refrigerant gas is used in a completely closed system. Furthermore, the various freezer operations are computer controlled. As this description demonstrates, a soft serve freezer is not simply a vending machine; it is actually a manufacturing equipment. The soft serve freezer is a familiar object that delivers, along with soft serve ice cream, a smile to the face of the customer.

Nissei manufactures its freezers independently. When these freezers are manufactured at Nissei's Takatsuki factory (in Osaka Prefecture) and cleaned for maintenance, ULVAC vacuum pumps play an important role in the process for breathing life into freezers by filling them with refrigerant gas. With the aim of delivering greater ease of use and improved management features, Nissei developed its next-generation CI series of soft serve freezers and started selling them in October 2016. These machines are equipped with a system for recording operations (data logging) and they meet the standards required under Hazard Analysis and Critical Control Point (HACCP; a food hygiene management system), which helps to enhance food hygiene management. Moreover, at the Higashi-Matsuyama factory in Saitama Prefecture, ULVAC's surface processing technology is used in cast molding facilities for the manufacture of Tuiles, a type of cone made under the "Nissei Oven Factory" brand.

Aiming to become the No. 1 soft serve ice cream manufacturer with unique selling points The happiness of sharing bonds with other people "Smile Soft Project"

Nissei manufactures cones, soft serve mixes, freezers, topping sauces and other related items independently and

NISSEI OVEN FACTORY

A Tuile cone, part of the "Nissei Oven Factory" brand

Next-generation CI series of soft serve freezers.
Released in October 2016 this new product series was designed with the aim of delivering greater ease of use and improved management features.

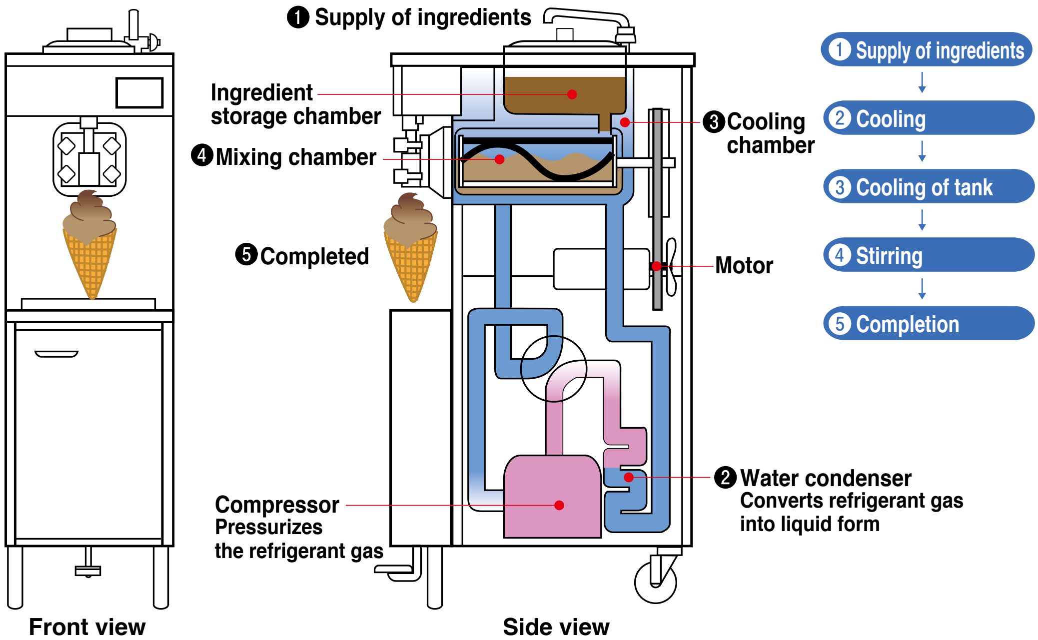


Figure 1: Mechanism of a soft serve freezer

JAPAN PREMIUM
にっぽんのブランド果実をまるごと贅沢に。

FOOD ACTION NIPPON
日世は国産果実消費拡大に貢献します。

Nissei Soft Dream Van

Marketing characters that customers have long been familiar with, "Nikkun" and "Seichan" were given names by a public vote in 2010

Best Smile Award, presented by KidZania

Nissei Pilot Shop

SOFTCREAM LAND Sweden

Softcream Land Sweden, Hankyu Sanbangai Store (Umeda, Osaka)

dolci cafe SILKREAM

Dolci Café Silkream, Shibuya Store (Shibuya, Tokyo)

also provides comprehensive business management services, including store backup services. As a leading comprehensive soft serve ice cream manufacturer, we continue to take up new challenges. Soft serve ice cream may have originated overseas, but Japanese soft serve ice cream today has its own unique features, including a wide range of flavors and a rich variation of cones. An enormous variety of local soft serve ice creams are available, each of which has its own unique flavor and is made from the local products of well-known tourist spots throughout Japan. "Japan Premium", made only from fruits grown in specific areas of Japan, are manufactured based on the concept of "whole luxury fruits." These seasonal limited products include soft serve ice creams made from Amao strawberries grown in Fukuoka, mangoes grown in Miyazaki, white peaches grown in Okayama, and La France pears grown in Yamagata. As a partner of the Food Action Nippon program, Nissei aims to increase the food self-sufficiency rate by expanding the consumption of agricultural produce grown in Japan.

Nissei also conducted a questionnaire survey targeting 1,000 persons with the aim of better understanding what is important to our customers when it comes to soft serve ice cream. The survey revealed that the respondents associated the following images with soft serve ice cream: flavors that are liked by everyone; something special that we eat outside the home; or something that we eat together with someone close to us. Based on these results, Nissei believes that the core value of soft serve ice cream lies in the happiness produced by sharing bonds with other people. Therefore, to produce a network of smiles across Japan, we are carrying out the Smile Soft Project with the slogan: Soft Serve Ice Cream That Melts Hearts Together.

Nissei operates the Soft Serve Ice Cream Shop Pavilion in KidZania Tokyo and KidZania Koshien to convey the pleasure of delivering products full of dreams by providing children with a tasty, enjoyable experience. We also have our pilot shops in Umeda district of Osaka as well as Shibuya district of Tokyo, where we may create a bond with our customers.

As Great East Japan Earthquake Support program, we visited the disaster areas in our Nissei Soft Dream Van to offer soft serve ice cream, or raised funds at tourist spots by offering soft serve ice cream free of charge. Also, in our fruit preparation business, we purchased strawberries from Sendai at an appropriate price and returned the profits to the producers. On our website, we are conducting a campaign that awards prices to consumers who answer quiz questions correctly, or share easy recipes for homemade desserts made from Nissei products.

We are well aware that soft serve ice cream is not a necessity of life. Nevertheless, Nissei believes it is important to convey to future generations its founder's commitment to revitalizing Japan, bringing a new culture to the Japanese people and enriching their lives, and delivering comfort to customers. This commitment is attested by the company's attitude that we do not manufacture excessive cone products or reserve them for busy periods. As a comprehensive soft serve ice cream manufacturer, Nissei will continue using its proprietary technologies to provide safe, reliable, high-quality products with the aim of producing a network of smiles across the world.

The Japanese scientific community is producing many of the world's leading researchers in the field of elementary particle physics

Physics can be roughly divided into two disciplines: theoretical physics and experimental physics. The former seeks to develop theories to explain known empirical facts and natural phenomena or to study unexplained physical phenomena based on mathematical hypotheses. Prominent Japanese scientists in this discipline include Yoshio Nishina, Hideki Yukawa, and Shinichiro Tomonaga.

In experimental physics, however, experiments and observations are conducted in order to better understand natural or physical phenomena or to prove theories developed in theoretical physics. One of Japan's most renowned experimental physicists is Masatoshi Koshiba, who won the 2002 Nobel Prize in Physics for his detection of neutrinos.

Saeki: Professor Koshiba is a pioneer of Japanese experimental physics. Following his return to the University of Tokyo after studying in the United States, the professor led his own laboratory. The first three researchers to join his laboratory were Professors Shuji Orito, Sakue Yamada, and Yoji Totsuka.

I became a student of Professor Orito when I transferred from Waseda University to complete a master's degree at the University of Tokyo. So, I am essentially a second-generation pupil of Professor Koshiba.

I was only ever an average athlete during my childhood, but I loved to draw and ponder things—that's why I was sometimes called "child Buddha" [laughs]. I was good at science and math. At that time, science was all the rage. Rather than the class lectures and textbooks, though, I

VISION 42

Profile of Associate Professor Takayuki Saeki

Born in 1966

Mar. 1990	B.S. in physics, Department of Applied Physics, Faculty of Science and Engineering, Waseda University
Apr. 1992	M.S. in physics, Department of Physics, Faculty of Science, University of Tokyo
Sep. 1996	Ph.D., Department of Physics, Faculty of Science, University of Tokyo
Sep. 1996	Research Associate, University of Tokyo, International Center for Particle Physics (ICEPP)
Mar. 2004	Research Associate, Accelerator Laboratory, High Energy Accelerator Research Organization (KEK)
Apr. 2008	Senior Assistant Professor, Accelerator Division VI, Accelerator Laboratory, High Energy Accelerator Research Organization (KEK)
Apr. 2015-Present	Associate Professor, Accelerator Division VI, Accelerator Laboratory, High Energy Accelerator Research Organization (KEK)

Associate Professor, Accelerator Laboratory,
High Energy Accelerator Research Organization (KEK) (Inter-University Research Institute Corporation)
Dr. **Takayuki Saeki**

Learning About Infinitesimally Small World of Elementary Particles is the Springboard for Learning About the Vast Expanses of the Universe

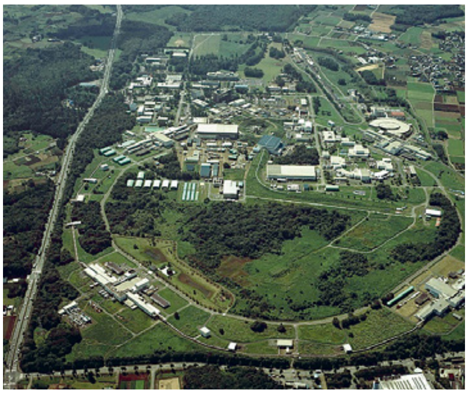
—The International Linear Collider (ILC) is Expected to Unravel the Mysteries of Life and the Creation of the Universe

"Large accelerators are a fitting symbol for elementary particle physics. Without them, we would be unable to carry out experiments to explore the world of elementary particles, and without these experiments, we would be unable to make advancements in physics."

The above statement is a quote from a book published* by Dr. Yoichiro Nambu, who was awarded the Nobel Prize in Physics in 2008 along with Dr. Makoto Kobayashi and Dr. Toshihide Masukawa. Dr. Nambu goes on to say that in order to unravel the mysteries of the universe, "the amount of energy produced by accelerators must be increased if we are to discover new elementary particles and investigate unexplained interactions." In other words, once studies have been conducted into all of the possible reactions that an accelerator can trigger, the accelerator no longer has a useful role to play. For any further studies, a new accelerator that can produce much greater energy is necessary. By leveraging the capabilities of researchers from all over the world, the High Energy Accelerator Research Organization (known as "KEK") is leading an international project to build the new International Linear Collider (ILC). In this "Vison" section on the ILC, we discuss accelerators and elementary particles with Associate Professor Takayuki Saeki, who is at the forefront of the accelerator cavity technology that underpins the ILC.

*** Yoichiro Nambu, Quarks, Second Edition, 1998, Kodansha Bluebacks**

KEK's History



Aerial view of the entire KEK Tsukuba Campus
(Source: KEK)

1971	High Energy Physics Research Organization established (Apr.)
1976	Proton accelerator (PS) succeeded in accelerating protons to 8 GeV (Mar.)
	PS succeeded in accelerating protons to 12 GeV (Dec.)
1982	Photon Factory (PF) succeeded in storing electron beam energy of 2.5 GeV (Mar.)
1986	Tristan Main Ring (MR) accelerated both electron and positron beams to 25.5 GeV (Nov.)
1998	B-factory succeeded in storing beams (Dec.)
	World's highest luminosity achieved, laying the groundwork for the Nobel-prize-winning theory by Dr. Kobayashi and Dr. Masukawa.
2009	J-PARC constructed jointly with Japan Atomic Energy Agency (Mar.)
	Long baseline neutrino oscillation (T2K) experiment commenced (Apr.)
2016	Beams successfully stored by the SuperKEKB (Feb.)

was more interested in specialist science publications. I studied them by myself and daydreamed about the Big Bang. I had already decided to become a researcher by going to university to study applied physics.

As we now know, the stars that we see in the night sky are actually hundreds of thousands of light years away, and what we see is actually images of them as they were at a point in the past as the light has to travel through the unimaginably vast universe before it reaches us. On hearing this, children in kindergarten or primary school tend to respond by asking: "But what's beyond the stars?" Grownups—and even great teachers—are unable to answer that question. Given this, I decided that I would have to figure this out for myself.

While I was studying for my doctorate from 1993 to 1995, I took part in a series of experiments in Canada where we used a balloon-borne instrument to observe cosmic radiation. For each experiment, the balloon was sent at the altitude of about 30 km into the air. After the observations had been completed, the rope was cut between the balloon and the instrument so that the observation instrument could be returned to the ground by means of a parachute.

Together with a retrieval team, the other researchers and I would then search the forests and fields for the landing instrument. If we couldn't use a car for the search, we would charter a military plane or trek by foot. My worst experience was when we had to search a marsh for the instrument. I learned the hard way that the job of an experimental physicist can be very tough—it can be physically demanding and require great perseverance [laughs]. The project leader back then was Professor Orito.

The Japanese physics community has produced many talented individuals who are leading the world in the study of elementary particles with the aim of unveiling the secrets of the universe. As a researcher, I too have benefited from the tutelage provided in this community.

KEK's accelerators have played a part in studies that have won the Nobel Prize for Physics

Elementary particles are the smallest component of a substance and they cannot be broken down any further. What we consider to be elementary particles has changed over time. Much of today's research into elementary particles is conducted in an effort to validate theoretic physicists' theories through a comparison with the results of experiments conducted by experimental physicists. If such research leads to a breakthrough, it could set us on the path to a new scientific civilization that is beyond conventional thinking.

Saeki: Research into the infinitesimally small world of elementary particles requires the use of special systems. Professor Koshiba, for example, studied neutrinos by observing them with a system called "Kamiokande", which is situated 1,000 m below the former Kamioka mine in Gifu Prefecture, Japan.

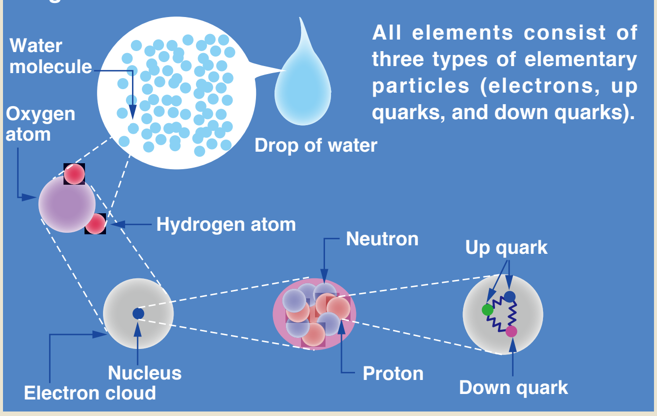
Sometime later, Professor Takaaki Kajita discovered evidence of neutrino oscillations based on the increased amount of observational data processed by "Super-Kamiokande", which has a capacity 15 times greater than that of "Kamiokande". This discovery was recognized with a Nobel Prize. In this experiment, a high intensity proton accelerator (J-PARC) operated by KEK was employed to artificially create and supply irradiate neutrino beams to "Super Kamiokande", which successfully observed the neutrino oscillations.

KEK's accelerator helped prove the existence of quarks as new elementary particles in line with the theories of Dr. Makoto Kobayashi and Dr. Toshihide Masukawa. Together with Professor Yoichiro Nambu, these theoretical professors won the Nobel Prize for Physics in 2008.

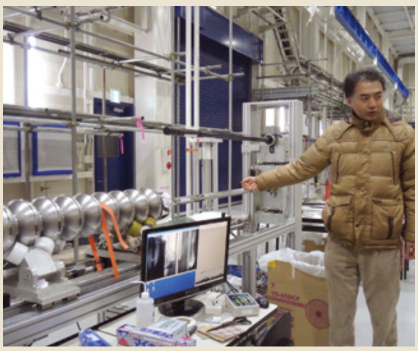
As a Japanese center of development for accelerator science, KEK provides opportunities for both Japanese and international researchers in related fields to conduct research using its various accelerators.

It may surprise some people to learn that applications of accelerator technologies can be found in our everyday lives. The microwave ovens found in most homes are based on the same principle as that of the high-frequency electromagnetic

Figure 1: What is water made of?



(Illustration created based on materials provided by KEK)



Superconducting accelerator cavity unit

An ideal vacuum is essential in accelerators. This photo shows an ULVAC ion pump.

field generators used in accelerators. Many other examples exist, including PET scanners for cancer screening, electron microscopes, sterilization units, X-ray diagnostic equipment, radiation therapy equipment, non-destructive testing equipment, and even obsolete appliances such as tube televisions.

The accelerator is an essential tool for elementary particle physics researchers.

Indispensable accelerators for elementary particle physics research

The microscope is a well-known tool for observing the world of the infinitely small. Theoretically speaking, though, it is impossible for a microscope to observe the molecular world at scale of 100 millionth of a centimeter—but an accelerator can.

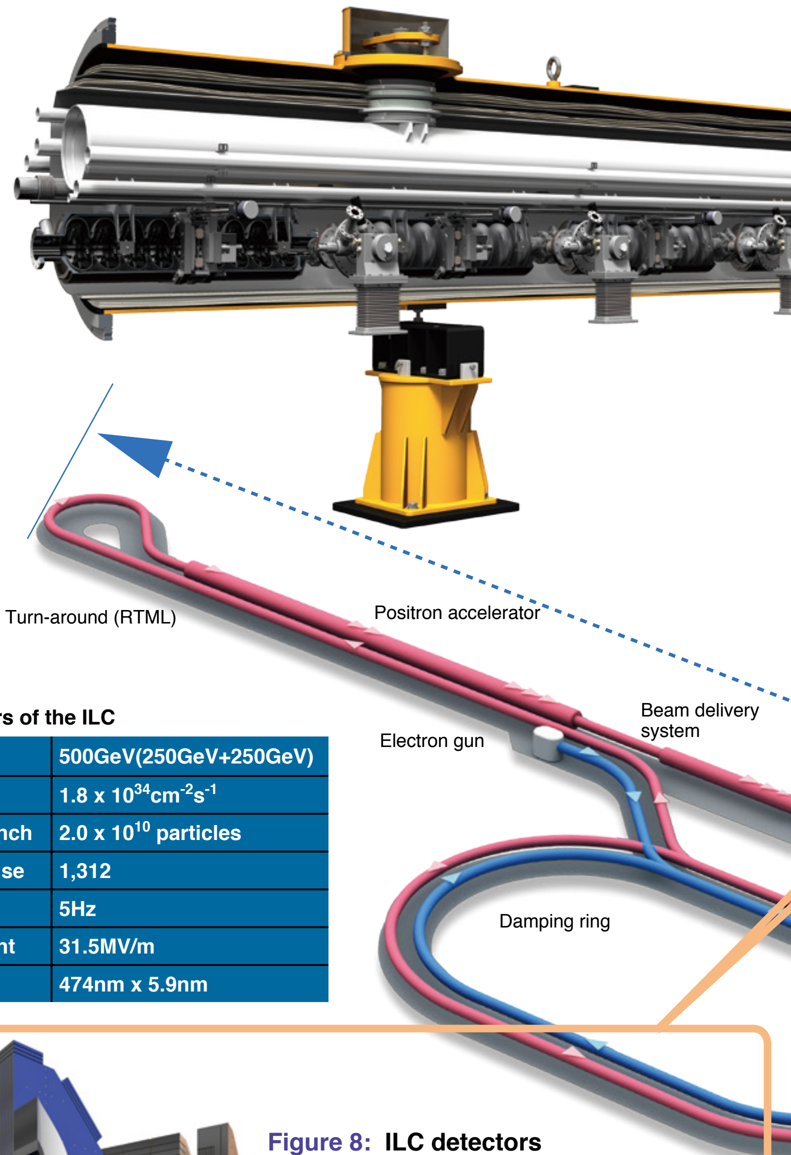
Saeki: The presence of electrons inside atoms was known as early as the late 19th century, and Ernest Rutherford attempted to visualize the internal structure of an atom in 1911. To do this, he collided alpha rays from radioactive elements at atoms to observe the degree of deflection or penetration. His experiments revealed that some negatively charged objects, which we now call electrons, were flying around some sort of a positively charged mass, which turned out to be the nucleus.

Mr. Rutherford's collision of alpha rays at atoms marks the beginning of accelerators, and the principle has not changed since then. As a matter of fact, accelerators are also referred to as colliders. As it turns out, such collisions must be made by accelerating particles with much higher energy in order to study the inside of the atomic nucleus in detail.

Initially, the atom was believed to be made up of electrons, protons, and neutrons. However, following the development of technologies for space observation and experiments with accelerators, the existence of minuscule particles—called quarks—in protons and neutrons was predicted in 1964. Their existence was proven in 1969 in an experiment conducted in America using an accelerator.

In 1973, a theory proposed by Dr. Kobayashi and Dr. Masukawa predicted the existence of six types of quarks, including up and down ones. As mentioned earlier, the theory was validated using a KEK accelerator. Subsequently, new particles believed to be the root elements of matter were discovered, such as the electron-like lepton. Today, we can no longer declare with any certainty that we have a definite conclusion.

In fact, it has been revealed that the particles forming hydrogen and other familiar substances only account for 4% of the entire universe. The mysterious dark matter and dark energy account for the remaining 23% and 73%, respectively. It is believed that research into dark matter and energy will help us to understand the beginning and evolution of the universe, so hopes for new accelerators are growing (Figures 2 and 3).



Key beam parameters of the ILC

Beam energy	500GeV(250GeV+250GeV)
Luminosity	1.8 x 10^{34}cm^{-2}s^{-1}
No. of particles / bunch	2.0 x 10^{10} particles
No. of bunches / pulse	1,312
Pulse frequency	5Hz
Acceleration gradient	31.5MV/m
Collision beam size	474nm x 5.9nm

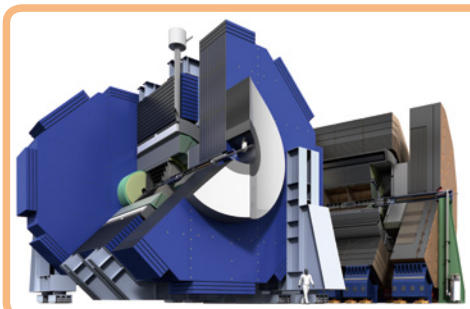


Figure 8: ILC detectors
(Image courtesy of KEK (c) Rey. Hori)
A collision detector placed at an interaction point (IP) between electron beams of 250 GeV and positron beams of 250 GeV captures the trajectory of particles involved in each interaction. The plan for a collision detector envisages the employment of ILD and SiD, and these two detectors will be used alternately in experiments.

Electromagnetic, strong, weak, and gravitational: the four fundamental forces mediated by elementary particles

Elementary particles are believed to mediate the four fundamental forces behind all interactions involving matter on the Earth, in the solar system, in the universe, and on any natural world that lies beyond. These four forces of interaction are the electromagnetic, strong, weak, and gravitational forces.

Saeki: Electromagnetism, the most familiar of the fundamental forces, can be observed with lightening and magnets. This type of force is mediated by elementary particles called photons and it acts among electrically charged elementary particles. Both weak and strong forces act among protons and neutrons inside the atomic nucleus. The strong force is mediated among quarks to keep the protons and neutrons inside the atomic nucleus. According to conventional thinking, protons inside the nucleus would repel one another due to their positive charges, but this does not happen thanks to elementary particles called gluons, which bond protons together with their strong force (Figure 3).

The weak force, which is carried by elementary particles called Z (W) bosons, acts on quarks and leptons to trigger nucle-

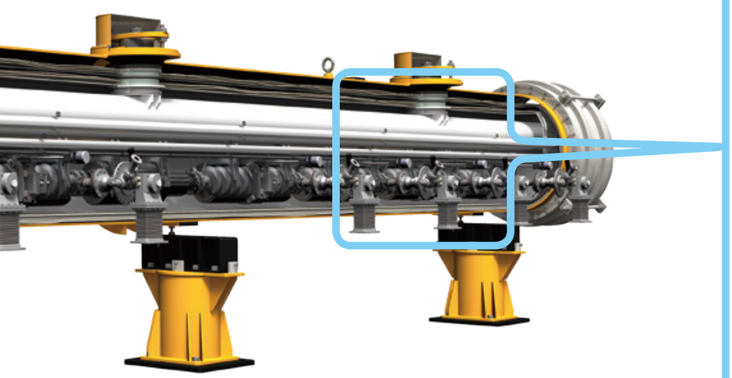


Figure 5: Cryomodule (Image courtesy of KEK (C) Rey. Hori)

Cryomodules are used in the KEK accelerator unit with a diameter of 1 m and a length of 12 m. Each module consists of a superconducting accelerator cavity unit or a superconducting quadrupole magnet, and a vacuum insulation vessel to provide thermal insulation for the helium piping. Two types of cryomodules are used: one houses nine superconducting acceleration cavity units, while the other houses eight superconducting acceleration cavity units and one superconducting quadrupole magnet. In the ILC, 1,680 cryomodules are installed in a straight tunnel underground.

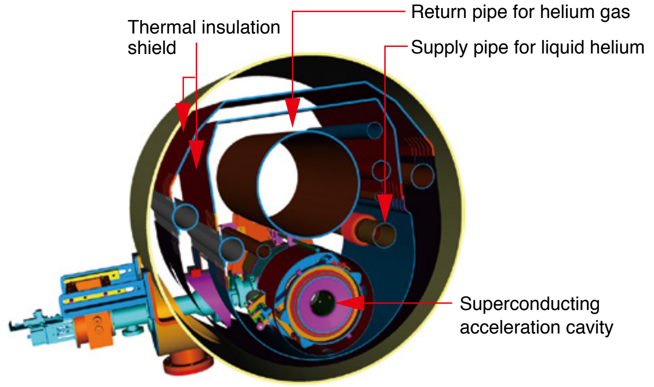


Figure 7: Cross section of cryomodule
(Image courtesy of E-XFEL/DESY)

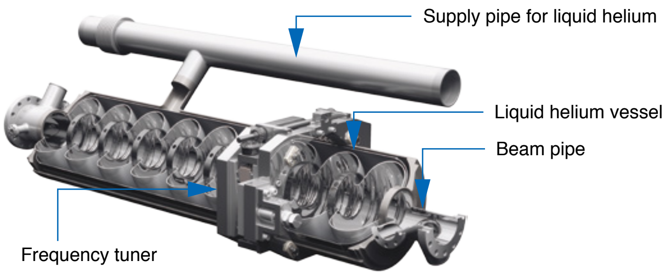


Figure 6: Superconducting acceleration cavity unit
(Image courtesy of KEK (C) Rey. Hori)

A superconducting acceleration cavity unit is a system that integrates a 9-cell cavity with an acceleration gradient of 31.5 MV/m, a helium jacket around the cavity that can be filled with liquid helium, and a frequency tuning mechanism to maintain and control resonance in the cavity. A cavity made using niobium (Nb) becomes superconductive without electric resistance when it is cooled to an absolute temperature of 2 K (or -271℃) using liquid helium. It can generate a high accelerating electric field with a small amount of RF power.

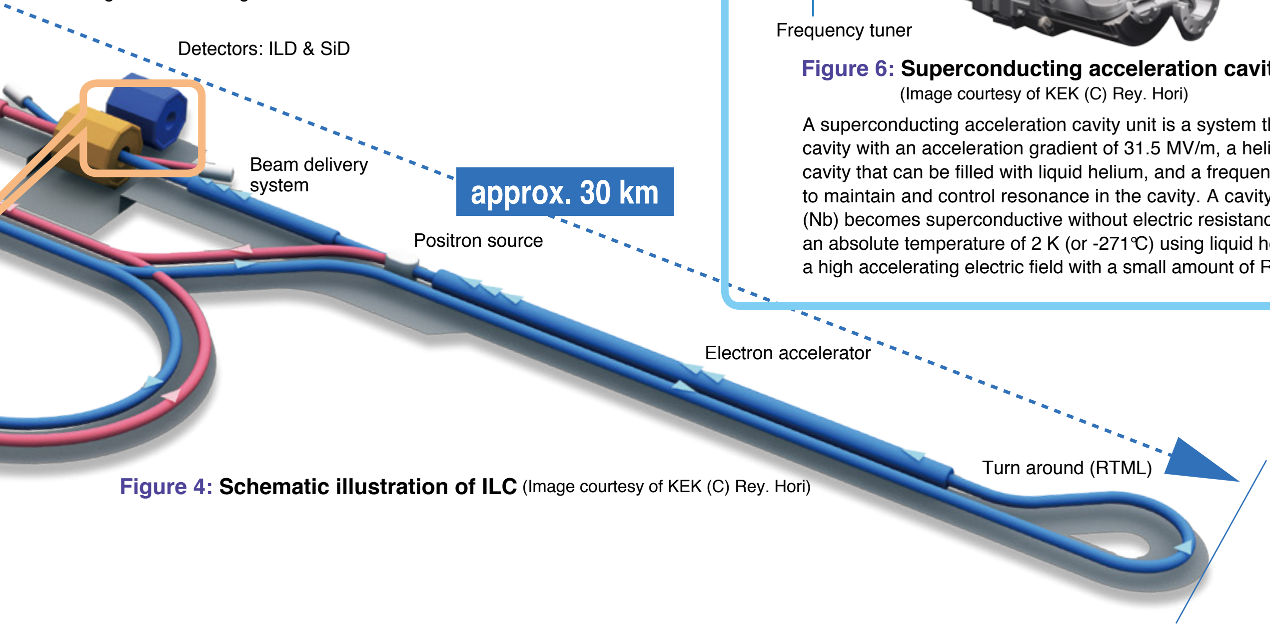


Figure 4: Schematic illustration of ILC (Image courtesy of KEK (C) Rey. Hori)

ar decay. It is owing to this force that our Sun is able to continue burning.

The gravitational force remains a complete mystery—nothing is known about it. This feeble force of attraction does not involve any positive and negative charges or any corresponding force of repulsion. It is so feeble that static electricity that has been built up on a celluloid sheet can lift up our hair. This phenomenon demonstrates that the force of attraction exerted on hair by a celluloid sheet charged with static electricity is stronger than the gravitational force exerted by the vast mass of the earth.

In 1964, the existence of the Higgs boson was predicted to be an elementary particle that is related to gravitational force (and mass). It took a state-of-the-art accelerator to finally confirm its existence in 2012. It is considered to be responsible for

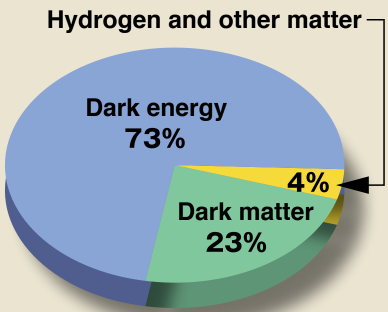


Figure 2: Composition of the universe
(Image courtesy of KEK)

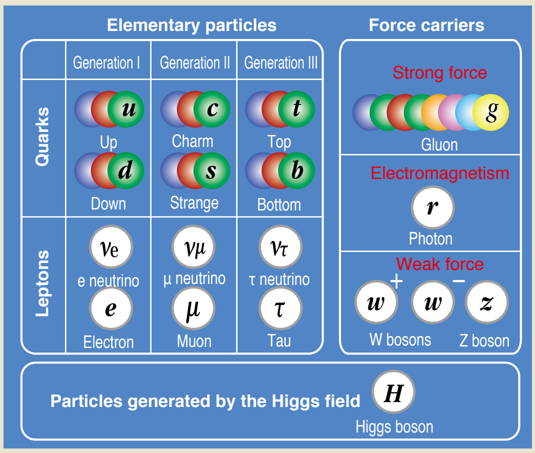


Figure 3: Elementary particles that shape the universe
(Image courtesy of KEK)

Figure 9: With a circumference of about 27 km, the Large Hadron Collider is the world's largest accelerator. It is operated by CERN in Geneva, Switzerland. (In comparison, the distance travelled by the Yamanote railway line that encircles central Tokyo is 34.5 km. Lake Geneva and Geneva Airport can be seen in the background of the photo behind the circular accelerator) © 2001–2017 CERN

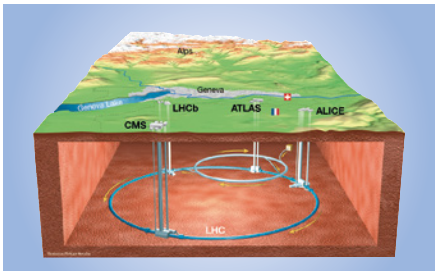
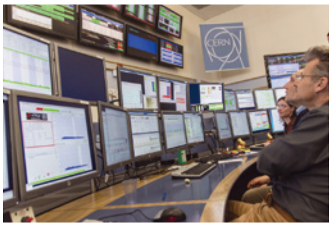


Illustration of the underground installation of the LHC © 2014–2017 CERN

ATLAS Experiment © 2016CERN



LHC control room
© 2015–2017 CERN

Inside the LHC tunnel
© 2015–2017 CERN

the mechanism that causes the respective elementary particles to acquire a specific mass.

ILC: a linear collider that could help unravel the Big Bang

An accelerator is used to observe phenomena at the interaction points where particles are brought into collision. This experimental system may not seem to have anything to do with understanding the universe, but observing phenomena at one infinitesimally small point provides clues to unravelling the mysteries of the beginning of the universe and the origins of life. In other words, we can learn about the vast expanses of the universe by studying the behavior of infinitesimally small elementary particles.

In 2008, construction of the Large Hadron Collider (LHC), the world's most powerful accelerator, was completed by the European Organization for Nuclear Research (CERN). This vast circular accelerator has a circumference of around 27 km, which is almost the same distance as the length of the Yamanote railway line that encircles central Tokyo. It was this CERN accelerator that successfully observed the Higgs boson (Figure 9).

Saeki: The LHC accelerates two proton beams travelling in opposite directions over the course of a number of laps before particles carrying great energy eventually collide.

Importantly, each proton is a combination of three quarks. Basically, a proton is a mixture of particles. Conducting an analysis of how the behavior of particles changes as a result of their collision is complex and prone to errors. One disadvantage is that particles accelerated close to the speed of light by a circular accelerator lose a huge amount of energy by emitting light and discharging electricity.

To overcome these challenges, pure electrons and positrons (the antimatter of electrons) need to be brought into collision with much greater energy. This is how the proposal for the development of a linear accelerator ILC came about (Figures 4 and 8).

Saeki: In a sense, the ILC is a huge experimental system that recreates the Big Bang inside it with the aim of unravelling the mysteries of the universe. Unlike circular models that can accelerate particles multiple times as they travel along their rings, a linear accelerator has only one chance to bring particles into collision. The probability of a collision must be increased as much as possible to make up for this disadvantage. Consequently, collections of electrons and positrons must be focused into dense beams. This function is fulfilled by the dumping ring and the final focus system shown in Figure 4.

The groundbreaking mechanism of the ILC

The ILC is an international project that is intended to allow researchers from Asia, North and South America, and Europe to collaborate in elementary particle research. Japan is the most promising candidate for securing the project, and the mountainous areas of Kyushu and Tohoku have been named as candidate sites for the construction of the accelerator.

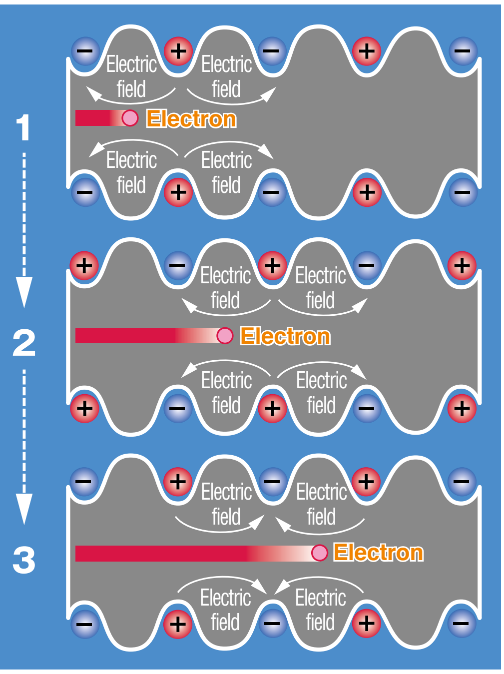
With the Higgs boson having been discovered at the LHC in 2012, there are high expectations that the improved functionality of the ILC will help us take the next step toward a new research theme.

Saeki: Starting in 1996, I spent six years carrying out research at CERN. The tunnel, where the LHC is today, used to house the

Figure 10:
The driving force behind linear acceleration

As shown in the figure, the ILC accelerates electrons with alternating electric fields (i.e., positive and negative).

The exceptional designed energy efficiency for the high-frequency power in the L-band (1.3 GHz) is produced thanks to superconductivity, with a temperature maintained at -271°C (2K) by cooling the superconducting acceleration cavity from the outside with liquid helium.



(Illustration created based on materials provided by KEK)

Large Electron–Positron (LEP) collider. In those days, the accelerator was use to conduct experiments where electrons and positrons were brought into collision. I studied the pair production of elementary particles called W bosons using the LEP collider. Later, CERN converted the LEP collider into the LHC. Following my return to Japan in about 2003, I began working in earnest to turn the ILC project into reality. Even if the newly completed LHC discovered the Higgs boson, questions regarding dark matter and energy would not be completely answered—that is why I believed that an even more upgraded accelerator would certainly be necessary.

To raise the energy of electrons (or positrons) by accelerating them in multiple stages, the ILC consumes vast amounts of electric power. Furthermore, in order to efficiently harness a strong current, superconducting technology is employed in the cavity units that accelerate the particles. These superconducting cavity units are cooled with liquid helium. Thermal insulation is ensured through the use of surrounding cryomodules that resemble giant thermos flasks. This is my specialist area (Figures 5–7).

Superconducting acceleration cavity units are made of niobium, a superconducting rare metal. Other outstanding superconducting materials called high-temperature superconductors do exist at present, but most of these ceramic-like (or earthenware-like) materials cannot form the complex, curved caterpillar-shape used for these cavity units. That is why we use niobium as a superconducting pure metal. Niobium is certainly an expensive rare metal, but a significant cost reduction is expected if a film of niobium can be formed on the inner surface of a copper mold. Similarly, applying a thin film of a high-temperature superconductor on the inner surface of the cavity would resolve the issue of workability and deliver excellent superconducting performance. In other words, it may be possible for a superconducting accelerator to operate at the temperature of liquid nitrogen in the future. Such an advanced thin film technology would help to reduce the size of superconducting accelerators dramatically and slash production costs. We hope to develop such a technology through joint research between ULVAC and KEK (see the column below).

The acceleration of electrons (or positrons) by an alternating (i.e., not one way) electromagnetic field in the ILC is carried out based on the mechanism shown in Figure 10. Technically, it is much easier to handle direct current, but accelerating to a high speed using this would require a correspondingly high voltage, which in turn would cause internal sparks (basically lightening) and destroy the accelerator.

As shown in the figure, the application of alternating current can accelerate particles without raising the voltage, thereby avoiding the generation of sparks.

Significance and mission of the ILC project implemented by Japan as a leading scientific nation

Children and adults alike wonder about how the universe came into being and what lies beyond the universe? Research conducted using the ILC attempts to answer genuine questions such as these. With a smile on his face, Associate Professor Saeki says with absolute certainty that the newly installed ILC contributes something more than just immediate and direct gains.

Saeki: I have no doubt that, over the next few years, the ILC will make an immense contribution toward the advancement of our scientific civilization. I am very confident about its potential.

Dr. Saeki stood next to a cryomodule

Elementary particle physics researchers around the world openly share their research findings across borders. Through friendly competition, they strive to unravel the mysteries of the beginning of the universe and the origins of life through tireless research.

The implementation of the ILC project is extremely costly. Given this, the project cannot be realized without the full understanding and support of the Japanese public and government.

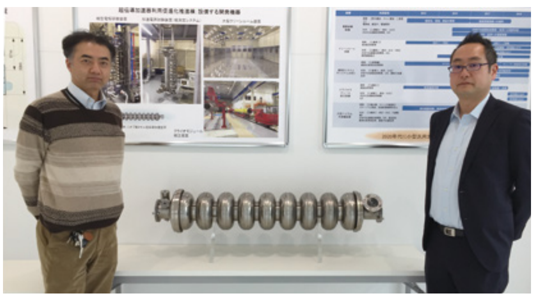
Even the groundbreaking findings achieved by the ILC do not mark a definitive end to our quest for knowledge. Take dark matter and energy, for example. The more we know in science, the more unexplained fields of research emerge. Indeed, as soon as we reach one destination, it becomes a new starting point. Sooner or later, the ILC will need to be replaced by another accelerator.

It is no exaggeration to say that I am devoting all of my energy to implementing the ILC plan. I believe that the ILC will be of benefit to the scientific researchers of the future, including those who are still in school today. It will certainly lay the foundations for scientific advancement in Japan.

Tomohiro Nagata

Manager, Advanced Material Research Section, Future Technology Research Laboratory, ULVAC, Inc.

A powerful tag-team for the advancement of science



Nagata and Dr. Saeki (left) stood in front of a superconducting acceleration cavity unit

During my temporary assignment to KEK in fiscal 2012, I had the opportunity to work with Dr. Takayuki Saeki. Even today, I still draw on the time we spent together assembling measuring instruments and engaging in deep discussions late into the night.

Building on this experience and my human network from those days, my current group is engaged in joint or collaborative research with KEK based on three themes. One is the joint research that we began in fiscal 2016 with Dr. Saeki regarding an accelerator component called the superconducting thin-film acceleration cavity. This research is aimed at validating and commercializing a theory predicting that accelerator performance can be significantly enhanced through the use of thin-film superconductors. In this research, KEK is able to leverage its knowledge of superconductivity and accelerators, while ULVAC contributes through its strong background in thin-film technologies.

Lately, the application of thin-film technologies has begun to attract considerable attention. We consider this joint research with Dr. Saeki to present a great opportunity for us to demonstrate ULVAC's technical sophistication. At this stage, we are carrying out a basic verification, after which we will forge ahead toward commercialization by overcoming the challenges we face one by one.

ULVAC COATING CORPORATION (ULCOAT) is one of the world's few manufacturers of mask blanks*1. Its head office and factory are in Chichibu, a city in Saitama Prefecture that is well known for hosting one of Japan's top three festivals that feature floats: the Chichibu Night Festival*2. In close partnership with its nearby subsidiary FINE SURFACE TECHNOLOGY CO., LTD. (FST), ULCOAT produces high-quality leading edge mask blanks. In 2001, the company also set up a manufacturing hub in Taiwan as a part of its active overseas business expansion.

For this edition's VISITING ULVAC, we interviewed Yoshinori Gonokami (President and CEO of ULCOAT) and Hiroyuki Nawa (President and CEO of FST) to learn more about their current operations and their future prospects.

Yoshinori Gonokami, President and CEO of ULCOAT (left)
Hiroyuki Nawa, President and CEO of FST (right)

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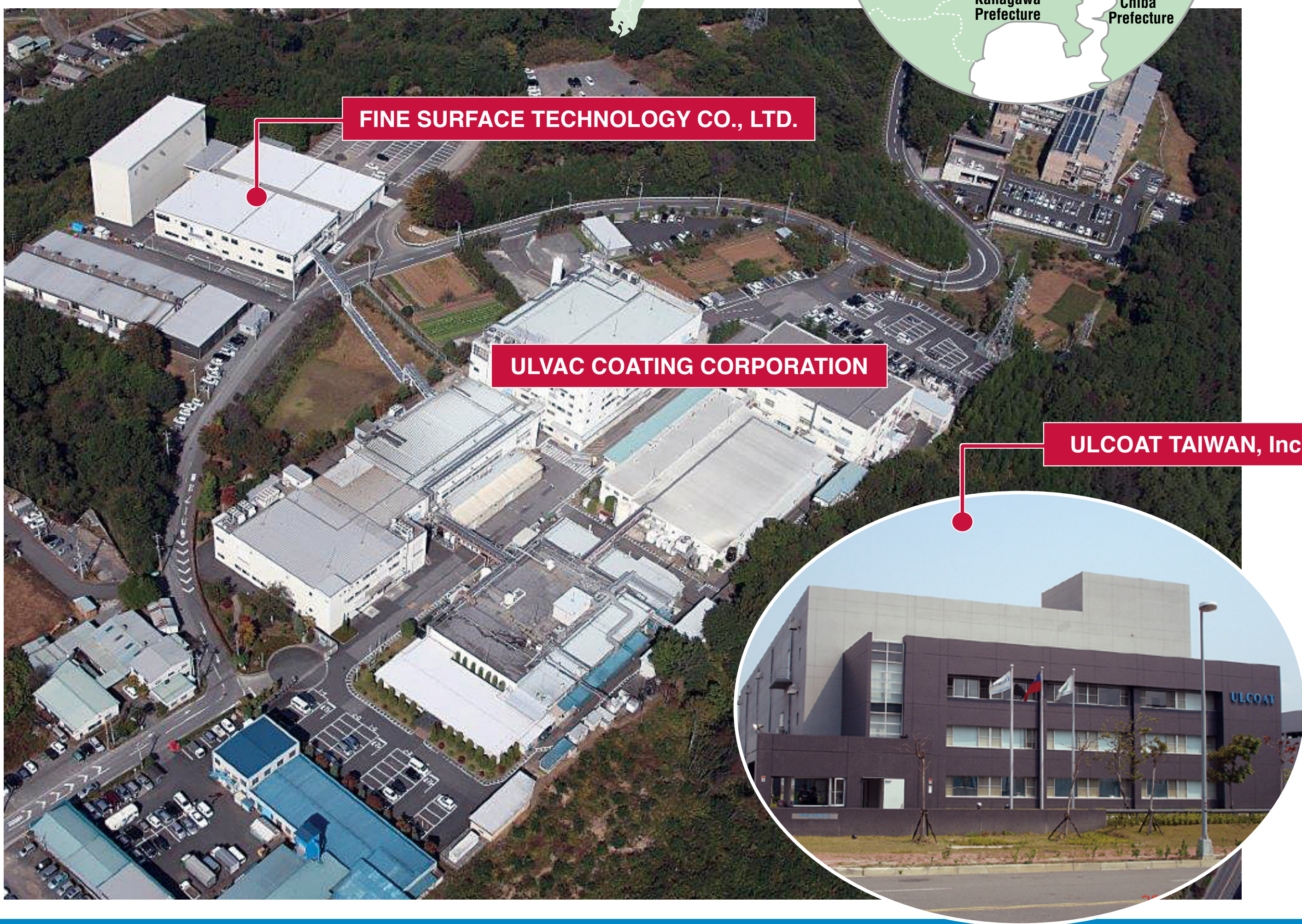
VISITING ULVAC

Companies with Roots in their Local Communities Underpin the Global Manufacturing of Semiconductors and FPDs

—A passion for delivering a stable supply and outstanding quality through comprehensive quality control



Exterior view of the ULCOAT site

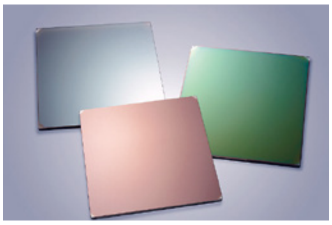
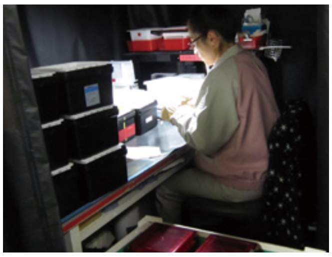
Introduction

ULCOAT is a spin-off company of Japan Vacuum Engineering Co., Ltd. (now ULVAC, Inc.) that was established in 1979 with about 50 employees transferred from the SI Department to the site of ULCOAT's current head office and factory in Chichibu. The company carried on the SI Department's mission of manufacturing and selling hard mask blanks and transparent conductive films for liquid crystal displays. At that time, they not only sold the equipment that they manufactured, but also attempted to create new products using their self-manufactured small deposition devices and sputtering devices with the aim of expanding the business applications for their technologies. Through these efforts, the company has been able to make a significant contribution to the miniaturization of integrated circuits, as exemplified by the pioneering development of mask blanks made using low-reflection chromium film in 1972. ULCOAT was established with the intention of scaling up these new lines of businesses.

Today, the company manufactures and sells large mask blanks for displays (e.g., LCDs and OLEDs) that boast nearly 60% of the global market, glass MEMS, along with mask blanks for the semiconductors that have been our core products since our establishment.

As of December 2016, the company has capital of 100 million yen and 190 employees.


Large mask blanks



Mask blanks for semiconductors (top)
Each glass substrate sheet is visually inspected in a dark room to check for scratches (bottom)

***1 Mask blanks**
Mask blanks are finely polished glass substrates coated with a light-shielding film (e.g., chrome) and a photosensitizing agent (resist). To fabricate a photomask, the circuit pattern is drawn using an electron-beam writer or another such device and the exposed area is then removed and etched.

Future Vision

Large mask blanks expected to boost market share

Yoshinori Gonokami
President and CEO
ULVAC COATING CORPORATION

We expect demand for our products used in the production of semiconductors to grow in the wake of a further boost in sales driven by the application of semiconductors in relation to the Internet of Things (IoT) and artificial intelligence (AI). In particular, we aim to actively expand our market share by enhancing the quality of ArF and KrF phase-shift mask (PSM) blanks intended for the high-end market.

We will proactively pursue the development of large mask blanks to increase our market share of PSM blanks for high definition displays, along with for semiconductors. In China, the demand for large mask blanks is expected to grow in line with surging investment in OLEDs, and we are determined to seize the opportunity that this presents.

Expanding capital investment in the group-wide pursuit of enhanced technologies and quality

At present, ULCOAT produces mask blanks mainly for general-use semiconductors. The company is expanding its investment in equipment and human resources with the aim of making further inroads into the high-end market and increasing its share from its currently low level.

A project for improving product quality was launched in 2014, and this project was taken over by the re-established Research & Development Division in 2016. In partnership with ULVAC, ULVAC Tohoku, ULVAC Techno, and other group companies, another project was undertaken to deliver the world's highest level of quality in mask blank manufacturing. A group-wide effort will be made to boost product quality.

ULCOAT is able to produce one of the world's largest mask blanks (2,100 mm by 2,600 mm), and its blanks are commonly used in LCD process. The company leads the world in the manufacture of large mask blanks owing to its ongoing development and capital investment aimed at producing ever larger products.

In keeping with the globalization of the display business, ULCOAT Taiwan Inc. (ULT) was established in 2001 to serve as a production hub for the Asian market. This move was also intended to stabilize supply through the operation of two production hubs: one in Japan and one in Taiwan. Plans are underway to proactively pursue further capital investment in Taiwan.

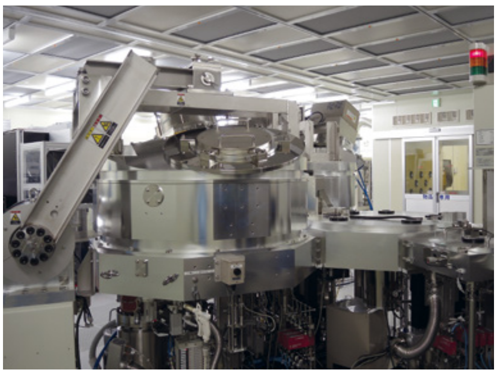
An open corporate culture delivers performance transparency and better employee mindsets

Every day, ULCOAT discloses its financial statements internally. All of its employees are able to view the sales and profits from the previous day and their forecasts for the same month through this system. This system was implemented in accordance with the policy of Gonokami, ULCOAT's president and CEO, who felt that it was important for all employees to understand the company's financial standing and business challenges. FST and ULT also disclose its financial statements to employees on a weekly basis. At the beginning of every month, each of these three companies organizes an "open meeting" at which their president explains directly to the employees the company's financial state and how their manufactured products are being used in end products. Employees who rarely have an opportunity to leave their work sites listen attentively to these presentations, which have been found to lead to reduced costs and greater motivation among employees.

Furthermore, each employee is encouraged to make two improvement proposals a month. A survey is carried out as part of the company's tireless efforts to improve the mindsets of its employees. In this way, ULCOAT remains committed to pursuing a goal that seems obvious but is, in reality, difficult to achieve: the provision of reliable products that customers can use without any cause for concern by improving product quality and the attitudes of individual employees.

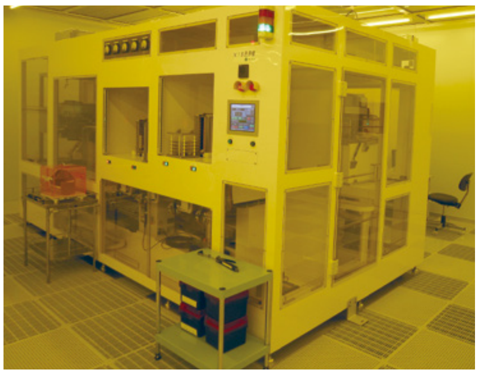
Invigorating employees and the community through local activities

On December 2 and 3 every year, a night festival is held in Chichibu, a city in Saitama Prefecture where the company's head



Sputtering equipment for forming chromatic and other types of film on substrates

Sputtering equipment



Cleaning equipment

Exterior view of the FST site

FINE SURFACE TECHNOLOGY CO., LTD. (FST)

FST was originally a polishing company headquartered in Hiratsuka, Kanagawa Prefecture. The company established an office and factory in Chichibu, Saitama Prefecture, in 1979 following the establishment of ULCOAT there. Its headquarters were relocated to Chichibu in 1985, and the company became a wholly owned subsidiary of ULCOAT in 2005. At present, the company performs precision polishing of glass materials to make substrates for mask blanks and blasting of sputtering parts.

Their products are mostly supplied to ULCOAT. As of December 2016, the company has capital of 10 million yen and 85 employees.

office and factory are located. The festival is famed for its ornate floats lanterns decorations that make their way around the city for two nights to the accompaniment of drum and flute music. The largest float is 15m tall and weighs 20 tons!

The winter fireworks festival is another attraction that accompanies the Chichibu Night Festival. At this festival, which is co-sponsored by ULCOAT, starmine fireworks are launched one after another for two and a half hours.

Every year, ULCOAT and FST jointly organize a sports festival at a gymnasium located in the city to foster employee integration. The next one will be the seventh such festival. Many couples and children enjoy participating in this popular event. Gonokami has said that he is glad to see smiles on the faces of the company's employees and their families as they enjoy the festival.

Future Vision

Evolving from being just a polishing company to pursuing new added value as a manufacturer

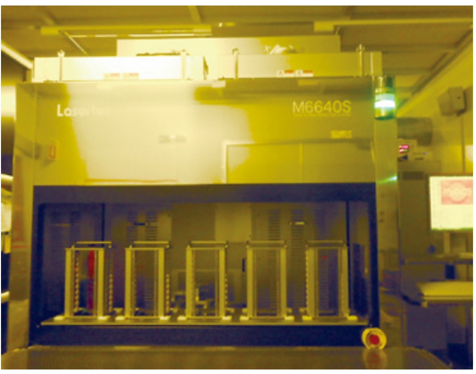
Hiroyuki Nawa
President and CEO
FINE SURFACE TECHNOLOGY CO., LTD.

FST is single minded in its pursuit of the elimination of defects and the creation of a perfectly flat surface.

The flat surface of a photomask material that has been polished using FST's proprietary technologies has an flatness of as little as 0.3 µm or less. If we scale this flatness up to the entire area of Dubai UAE, the height difference would be a mere 12 cm.

Given this, our polishing technologies are clearly some of the best in the world. We aim to expand our sales channels by leveraging these core technologies. Furthermore, with a view to evolving beyond being just a polishing company, we are working to add new value as a manufacturer.

***2 The Chichibu Night Festival is the main event of the annual festival held at the Chichibu Shrine. With a history stretching back over 300 years, this festival is one of Japan's top three festivals that feature floats (the other two being the Gion Festival in Kyoto and the Takayama Festival in Hida). On December 1, 2016, the festival was designated by UNESCO as intangible cultural heritage.**



A defect inspection system for mask blanks

Potekuma-kun, a cross between a potato (the city's local specialty) and a bear that serves as Chichibu's mascot and brand ambassador, also joined the sports festival.

Children playing a game that involves tossing balls into a net

ULVAC Festival 2016 attended by 6,000 people

— ULVAC, Inc.

On November 12, 2016, ULVAC Inc. held the ULVAC Festival 2016 at its Chigasaki head office and factory as our gratitude to all ULVAC employees, their families and local residents. During this festival, which was being held for the first time in six years, we organized various events to entertain visitors based on the theme of "From Chigasaki with Love."

As well as various fair stalls and employee-run refreshment stands being available, a wide variety of events were held on the day of the festival, including the following: factory tours; vacuum experiments; concerts, cheerleading performances and other stage events performed by company music bands and local junior and senior high school brass bands; a Shonan Bellmare soccer workshop; product exhibitions by Japanese and overseas ULVAC Group companies; a rice cake pounding ceremony; and workshop events run by the Chigasaki Fire Station. Every one of these events was packed with visitors.

Thanks to fine weather on the day, the festival was attended by more people than we expected and it ended without problem thanks to the generous support and cooperation of the participants and co-sponsoring organizations.

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ULVAC awarded the FY2016 Kanagawa Global Environment Award in the Global Warming Prevention Planning category

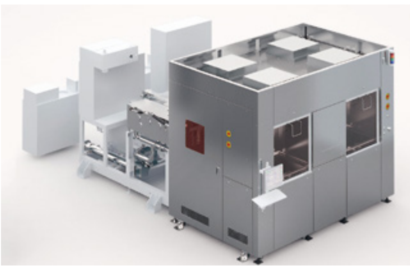
— ULVAC, Inc.

ULVAC, Inc. received the FY2016 Kanagawa Global Environment Award, which is sponsored by Kanagawa Prefecture and the Kanagawa Global Environmental Conservation Promotion Association. The Kanagawa Global Environment Award system is designed to praise and recognize the contributions of organizations and individuals who are engaged in global environmental conservation activities. Such activities include practical programs that are based on the initiatives stipulated in "Our Environmental Action Declaration: Kanagawa Ten Environmental Actions" as well as outstanding programs that have been developed based on the Kanagawa Prefectural Ordinance to Prevent Global Warming and the Kanagawa Prefectural Ordinance to Promote Use of Renewable Energy. Awards are available in four categories: Global Environmental Conservation; Global Warming Prevention Planning; Greenhouse Gas Emission Reduction

New Products

ULVAC, Inc.

NA-1500, a dry-etching system compatible with 600-mm square substrates for high-density packaging, launched



ULVAC, Inc. has developed the NA-1500, a dry-etching system that is compatible with 600-mm square substrates for high-density packaging. This system is designed to support a uniform descum process* for large square substrates.

In recent years, high-density packaging technologies have attracted attention in the semiconductor manufacturing industry, because improving the quality of high-speed, large-capacity data storage for the rapidly expanding large-capacity information device market requires the miniaturization of wire patterns to reduce wire resistance and eliminate stray capacity.

Also, as smartphones and other mobile devices acquire ever more functionality and become even slimmer, IC packages mounted on substrates are required to have more pins and to be thinner. Fan-Out Wafer Level Packaging (FO-WLP) was developed as a packaging technology that meets these requirements. The mass-production of products using this technology was launched in 2016.

As the next step toward lowering FO-WLP production costs, packaging companies are now working to reduce the size of substrates from 300 mm in diameter to approximately a 600-mm square (panel level packaging) and to increase the area ratio to approximately five times the previous level. Doing this will help to achieve a dramatic reduction in costs.

There are many Φ200- or 300-mm dry-etching systems on the market at present, but a system capable of performing a uniform descum process or titanium-etching for 600-mm square substrates had yet to be developed. Responding quickly to market needs, ULVAC developed a dry-etching system for the mass-production of packaging substrates and quickly released it for sale.

As the IoT continues to develop, there is a growing need to further reduce the size of electronic parts, to make them thinner, and to minimize their power consumption. Consequently, technologies for the manufacture of high-density packaging substrates will continue to become ever more important.

* Descum process: Eliminates the scum produced by light-sensitive resin photolithography.

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ULVAC, Inc.

S-QAM series of complex sputtering systems for R&D launched

ULVAC, Inc. has developed its S-QAM series of complex sputtering systems for R&D with the aim of delivering maximum performance at a minimal cost. Sputtering is a vacuum deposition method that is used in the manufacture of semiconductors, electronic parts and

Technologies; and Kanagawa Smart Energy Planning. ULVAC received the award in the Global Warming Prevention Planning category.

For this award, the following ULVAC initiatives were highly regarded: our shutting down of clean rooms and R&D facilities as standard practice on non-business days and during the night at our Chigasaki head office and factory, which is our center of research and development for vacuum systems and other related equipment; our development of various energy-saving measures, including the improvement of facility management efficiency by integrating office areas, the visualization of power consumption for each department, and the creation of an energy-saving manual that summarizes methods and assessment approaches for reducing energy consumption for R&D equipment; and the reduction of CO_2 emissions for FY2014 by approximately 37% within five years compared to standard emissions (FY2009) by replacing the mercury lights in our clean rooms with LED lights and by installing solar panels and other equipment.

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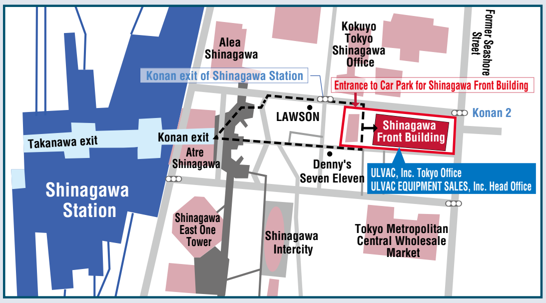
Notice of Office Relocation

ULVAC Inc. Tokyo Office & ULVAC EQUIPMENT SALES, Inc. Head Office

ULVAC, Inc. Tokyo Office and ULVAC EQUIPMENT SALES, Inc. Head Office moved to the following address in March 2017.
Start of operations: March 21, 2017

New address:
5th floor, Shinagawa Front Building, 2-3-13 Konan, Minato-ku, Tokyo, 108-0075
ULVAC, Inc. Tokyo Office
New phone no.: +81-3-5769-5005
(Finance Department)
ULVAC EQUIPMENT SALES, Inc.
(Head Office)
New phone no.: +81-3-5769-5511



- 3 minutes' walk from the Konan exit of Shinagawa Station
- 5 minutes' walk from the central ticket gate of JR Shinagawa Station
- 8 minutes' walk from the ticket gate of Keikyu Shinagawa Station

A record 10.5 million hours without accident (Class-4 Accident-Free Operations Record)

— ULVAC, Inc.

On January 18, 2017, ULVAC, Inc. managed to go a record of 10.5 million hours without the occurrence of an accident that would require a facility shutdown at its Chigasaki head office or factory and was awarded a Class 4 Accident-Free Record Certificate by the Ministry of Health, Labour and Welfare on March 13, 2017.

An Accident-Free Record Certificate (officially called a "Ministry of Health, Labour and Welfare Certificate of No-Accident Record") is awarded to companies in various industries depending on the number of hours worked without an accident. In ULVAC's industry, five types of certificates are available: companies are awarded a class-1 certificate for going 3.1 million hours without an accident, a class-2 certificate for going 4.7 million hours, a class-3 certificate for going 7 million hours, a class-4 certificate for going 10.5 million hours and a type-5 certificate for going 15.8 million hours. On this occasion, ULVAC managed to clear the number of hours required for a class-4 certificate.

We will continue to make steady efforts to ensure work safety with the aiming of achieving a class-5 accident-free record of 15.8 million hours.

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displays as well as automotive parts and building materials. In the R&D processes carried out prior to full-scale production, small-sized sputtering systems are often used to perform basic development and create testing conditions.

ULVAC has a wealth of experience in developing sputtering systems for R&D. In addition to our conventional CS series and QAM series, we have also responded to customer needs by expanding our product lineup to include the S-QAM series of systems for 20-mm square substrates with a focus on ease of use in R&D.

Features:
1. Reduction in target material cost
   Equipped with the world's smallest cathode at just 1 inch
2. Flexible deposition conditions
   (1) Equipped with up to six types of cathodes
   (2) Variable substrate–cathode distance
   (3) A rich lineup of high-temperature heaters
3. Greater ease of use
   (1) Automatic control available as a standard feature
   (2) Data logging available as a standard feature
4. Super-compact design

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https://www.ulvac-kyushu.com/

ULVAC-PHI, Inc.

PHI 5000 VersaProbe III : Multi-technique X-ray photoelectron spectroscopy (XPS) that offers greatly improved spectroscopic performance

ULVAC-PHI, Inc.'s VersaProbe series has been the world's most widely used XPS instruments since having been launched to the market. This time VersaProbe III has successfully improved their sensitivity performance of not only micro but also large area analysis, which is three times higher than previous models. VersaProbe III can also provide ultimate depth resolution thanks to its high-precision angular acceptance mechanism. A well-conceived multi-technique capability combined with diverse range of options and automated technology can provide superior and high throughput outcomes.

Features:
1. High-sensitivity microprobe analysis using a focused X-ray technology
2. High-sensitivity and multi-channel analyzer
3. Reliable automated technology
4. Turnkey dual beam charge neutralization
5. Easy-to-use navigation and automatic measurements
6. High depth-resolution with a low-energy argon gas cluster ion gun

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Full-scale production of large-scale manufacturing equipment for FPD/ PV panels in Suzhou, China

— ULVAC (SUZHOU) Co., Ltd.

ULVAC (SUZHOU) Co., Ltd., which has its head office and factory in China's Suzhou city, has begun full-scale local production of large-scale manufacturing equipment for FPD/ PV (solar battery) panels in China. The company held a ceremony on July 18, 2016, to commemorate the start of production.

The commemoration ceremony was attended by more than 200 people, including local government staff, representatives of Chinese panel makers, solar battery manufacturers, the local media and suppliers.

Hisaharu Obinata, the then President and CEO of ULVAC, made the following opening address at the start of the ceremony:

"With the size of glass substrates having increased to G8.5 and G10.5, China has grown to become the largest FPD manufacturing in the world today. To support the further growth of the FPD industry in China, it is essential to localize the production of manufacturing equipment and the procurement of materials. This is also the policy of the Chinese government. ULVAC has made the decision to start manufacturing large-scale G8.5 systems in China, and today we celebrate the first step on the path to achieving that."

The production in China of large vacuum systems that offer the same high quality as Japanese-made products was urgently needed to increase the future size of the Chinese market. Our quick achievement of this goal has led to interested parties having great expectations for future developments.

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Presented with the Shanghai Vacuum Science and Technology Progress Award at a technology competition sponsored by the Shanghai Vacuum Society

— ULVAC (SUZHOU) Co., Ltd.

In December 2016, ULVAC (SUZHOU) Co., Ltd won the second prize of the Shanghai Vacuum Science and technology progress award which is sponsored by the Shanghai Vacuum Society. The prize was awarded for the Esz-R, a high vacuum evaporation system that the company developed for the field of LED and power devices independent ly. Esz-R received high praise for its design concept of the lift –off evaporation characteristics. At the same time, it has the characteristics of low production cost and large output. In the future, ULVAC (SUZHOU) Co., Ltd will continue to improve the performance of this system to expand sales in other fields such as semiconductors.

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Choong Ryul Paik, the Managing Executive Officer of ULVAC, nominated as a NAEK member

— ULVAC, Inc.

Choong Ryul Paik, Managing Executive Officer of ULVAC, was nominated as a member of the National Academy of Engineering of Korea (NAEK), which is equivalent to the Japan Academy, on January 1, 2017. This nomination was made in recognition of Paik's contributions to the domestic production of semiconductor and LCD manufacturing systems and the development of the vacuum industry. NAEK members include celebrated

Choong Ryul Paik (left)

ULVAC-PHI, Inc.

PHI Quantes : Dual Scanning X-ray Photoelectron Microprobe opens up new fields of application

ULVAC-PHI, Inc.'s PHI Quantes is X-ray Photoelectron spectroscopy (XPS) that has been equipped with two monochromatic X-ray sources to allow for high sensitivity analysis of microscopic areas as well as large areas: one is a source for hard X-ray (Cr Kα) and the other is a source for soft X-ray (Al Kα). Two monochromatic X-rays are available to be switched by automatically through the analysis software easily and an analysis point or area is precisely same between two sources.

PHI Quantes inherits the core technology of PHI Quantera II that has been developed over the years to provide a range of features, such as automated analysis, sample transfer, dual beam charge neutralization and high-level data processing.

PHI Quantes can open up new fields of XPS application that go beyond past common knowledge on XPS.

Features:

1. Equipped with a hard X-ray source
2. Equipped with dual monochromatic X-ray sources
3. The same area can be easily measured using two X-ray sources
4. Turnkey dual beam charge neutralization
5. Automated analysis by pre-defined procedures.
6. High voltage proof analyzer
7. Offers an expanded scope of application with two different energy ray sources; difference in depth of information
8. Unique feature: quantitative and qualitative analysis using Cr X-ray

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ULVAC CRYOGENICS INCORPORATED

Comprehensive in-house manufacturing leads to the development of the 4K-GM freezer, which offers high-reliability, outstanding performance, and low noise and vibration levels

Developed by ULVAC CRYOGENICS INCORPORATED, the 4K-GM Freezer is used in a wide range of industries, including medical care, analysis and semiconductors.

As the most inexpensive, simple and reliable means of obtaining cryogenic temperatures of around 4K (approximately minus 269°C), this freezer is used not only in the conducting of scientific research on phenomena in cryogenic temperature areas, but also for the performance of MRI and NMR spectroscopies that require high magnetic fields and the cooling of superconducting magnets in silicon single-crystal pulling systems.

Conventionally, liquid helium was used in great quantities as a cryogen (and released into the atmosphere in most cases) to cool materials to cryogenic temperatures. However, a serious shortage of helium supplies in recent years has created a rapidly growing demand for 4K-GM freezers, which do not require liquid helium as a cryogen.

ULVAC CRYOGENICS INCORPORATED used to manufacture GM freezers designed to cool cryogenic pumps, but the company started selling cryogenic application equipment and providing related services in 2009. At the same time, it also started selling GM freezers as a stand-alone freezing system.

The company had been selling two models of 4K-GM freezers—the UR4K03 and the UR4K10T—but it has now developed and released two new models to further expand sales: the UHE10 and the UHE15.

Taiwan Local Report

Participation in the Japan-Taiwan Seminar of Industry-Government-Academia Collaborations

Reporter: Stanley Wu,
Vice President of ULVAC TAIWAN INC.

On November 11, 2016, I participated in the Japan-Taiwan Seminar for the Promotion of Industry-Government-Academia Collaborations, which was sponsored by the Taipei Cultural Representative Office in Japan. This seminar was held to provide representatives of Japan and Taiwan with an opportunity to discuss the actual operation, future vision, and future hopes regarding the promotion of industry-government-academia collaborations at universities.

ULVAC TAIWAN INC. has been actively engaged in joint research with Taiwanese universities since the time when it was still called ULVAC Research Center TAIWAN, Inc. We have also maintained friendships with laboratories in Taiwan in recent years. In response to a request from Mr. Xie, who is currently the president of the Taipei Economic and Cultural Representative Office in Japan (a former prime minister, his standing is equivalent to that of an ambassador), ULVAC TAIWAN INC. introduced an international industry-academia collaboration project developed by ULVAC, Inc., a global company, in Taiwan.

On the day of the seminar, Mr. Guo, vice president of the Taipei Economic and Cultural Representative Office, gave an address. In addition, Tateo Arimoto, a senior fellow of the Japan Science and Technology Agency's Research Institute of Science and Technology for Society, delivered a lecture.

Furthermore, Mr. Manabu Tsujimura, Director and Senior Corporate Executive Officer of Ebara Corporation, and Professor Chen of the National Taiwan University of Science and Technology presented case studies to share the experience gained through industry-academia collaboration projects conducted at the University of Tokyo, the Tokyo Institute of Technology, and Tsukuba University. The idea of industry-government-academia collaborations between Japan and Taiwan is not necessarily a hotly debated issue, but the 70-seat conference room was packed on the day of the seminar. I was surprised that so many people were interested in deepening the relationship between Japan and Taiwan.

The bond between Japan and Taiwan is one of the strongest in the world, and we have always cooperated closely with each other during large-scale earthquakes.

I believe that maintaining business partnerships between Japan and Taiwan is essential if we are to further develop and globally advertise our high-tech consumer product export businesses for overseas markets as well as social life technologies. To this end, we aim to promote mutual cooperation based not only on emotional ties, but also on our ability to identify with each other due to the fact that we face similar issues, including population aging, natural disasters and an island nation environment.

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businessmen, scholars and researchers who are engaged in activities related to the development of Korea, such as policy consultations and proposals, international cooperation projects and programs for the promotion and dissemination of engineering technologies. Attended by policy committee members of the ruling and opposition parties, policy experts and news reporters, a policy forum is held each year in Korea's Diet Building to provide NAEK members with a platform to explain their policy plans and discuss them with those in attendance.

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ULVAC CRYOGENICS INCORPORATED

Improving efficiency in the supply of liquid nitrogen
Developing a liquid nitrogen generator

The liquid nitrogen generator developed by ULVAC CRYOGENICS INCORPORATED, a specialist manufacturer of cryogenic systems, is indispensable for devices and containers that require cryogenic environments, such as the cell preservation containers used in bioscience, superconducting magnets and scanning electron microscopes. These devices and containers require a periodic supply of liquid nitrogen, which conventionally took enormous amounts of time and effort in terms of its management and handling.

As the liquid nitrogen generator can be connected to liquid nitrogen preservation containers, it makes the supply of liquid nitrogen easy. Equipped with backup power sources, the generator is capable of supplying liquid nitrogen without a power supply even in the event of a disaster.

Principal uses:
Used in private companies and university laboratories to cool cryopreservation containers for cells, tissues and vaccines

- iPS cells
- Preservation of artificial insemination samples for stockbreeding
- Tumor cells, tissues and cultured strain cells
- Sperm and fertilized eggs
- Lymphocytes, blood platelets, bone marrow and white blood cells
- Animal organs and neural cells
- Bacteria and viruses
- Plant seeds

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