ISSN 0910-6170

Ultimate in Vacuum

ULVAC

A Community Magazine of ULVAC Group

No. 64

ULVAC

contents

PHOTOGRAPHS:
p.4, 8 Intel K.K.
p.10, 13 Toshiba Corporation Social Infrastructure Systems Company
p.11 NTT DOCOMO, INC.
p.15-17 Dr. Yoshio Mita, Associate Professor, The University of Tokyo
p.18-20 Toyama 2nd Plant of Fuji Yakuhin Co., Ltd.

PRODUCTION ASSISTANCE: Adopa Corp.

PUBLISHER: ULVAC, Inc.
Head Office / Plant: 2500 Hagisono, Chigasaki, Kanagawa, 253-8543, Phone: 81-467-89-2033
EDITING: Public Relations Magazine Editors, Corporate Communications & IR Team, Management Planning Department
ULVAC WEBSITE: http://www.ulvac.co.jp/eng/
*Names of companies, organizations, and job titles appearing in all articles are current as of the time they were written.

Printed in Japan (June 2014)

Aiming to Realize the Slogan “Cost is King”

—Intel’s Corporate Culture Underpins Its Growth

Guest: **Dr. Tsuyoshi Abe**

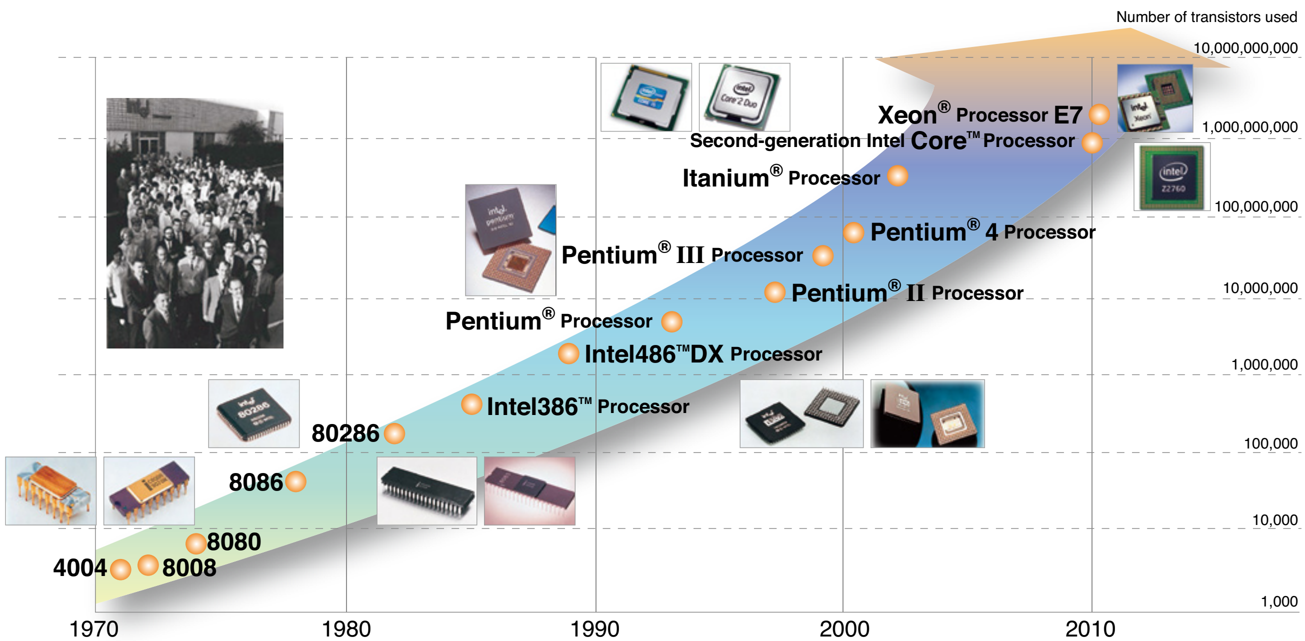
Director and Senior Executive Officer, Vice President
General Manager of Technology & Manufacturing Group Japan,
Intel K.K.

Interviewer: **Mr. Hisaharu Obinata**

President and CEO, ULVAC, Inc.

Intel is one of the world’s most outstanding companies. Using as its guideline Moore’s law, which was put forward by Dr. Gordon Moore, one of its founders, Intel has made extremely significant contributions to the advancement of semiconductor technology; the firm has continued as the top runner in the microprocessor market over 20 years. Underpinning this excellent performance is Intel’s outstanding technological prowess and production philosophy, as well as its relentless focus on cost reduction. The driving force behind Intel’s success is its corporate culture, which has been handed down from the firm’s founders and practiced by their successors to this day. This is also the manufacturer’s unique strength. This issue’s “Exective Guest” is Hisaharu Obinata, President and CEO of ULVAC, Inc., visited Dr. Abe, Director Vice President & Executive Officer at the Tokyo office of Intel K.K. We asked him about a range of topics, including Intel’s unique management philosophy and human-resource development programs.

The History of Microprocessors



Source: This chart has been created by ULVAC based on Intel materials.

The Birth of Big Data Leads to Competitive Advantage

Obinata: Previously, we asked you to give a lecture under the title "Big data driving big growth". Full of interesting stories, the lecture was really instructive. I've been looking forward to today's discussion. Let me go straight to the issue and ask you how big data can be used effectively.

Abe: Big data is highly likely to become the focus for corporate competitive advantage in the years to come, and as Internet use further spreads, the volume of data being handled will become increasingly larger. If considerable amounts of information are archived, these archives will provide information with high prediction power. A major American search site will become the world's largest archivist, where users can search useful information they want to obtain. Since the number of Internet users will grow further, increases in IT investments will have positive correlations with growth in the number of Internet users. So, the semiconductor market will also grow exponentially.

Obinata: At one time, the semiconductor industry was said to be a mature industry, but it still has the potential for further growth, doesn't it?

Abe: The point at which a sudden rise takes place is called the "tipping point", and the semiconductor industry will soon reach such a point.

Obinata: The phrase is really encouraging for semiconductor equipment manufacturers like ULVAC. It really fires us up .

Abe: According to a research firm, last year the semiconductor market was worth $330 billion dollars, and growing at an annual rate of a little more than 5%. In the future, the semiconductor industry will grow non-stop; by 2020, when the Olympic Games will be held in Tokyo, the market is expected to have expanded by about 50% compared to the current level. There are lots of industries out there, but semiconductors will be the top runner, and the industry is expected to continue growing in the future.

Obinata: The semiconductor industry will become one of the key targets for ULVAC's business. We really have to develop semiconductors into an even greater pillar of our business.

Intel's Strength is Reinforced by its Corporate Culture

Obinata: Intel has stayed in first place in the microprocessor (CPUs for personal computers) market over 20 long years. What are Intel's strengths compared to its competitors?

Abe: Intel was founded in 1968. At first, it was a manufacturer of memory chips (DRAMs). But in the 1980s, Japanese semiconductor manufacturers dominated the market, forcing American companies to struggle.

Obinata: Indeed, there was such a period.

Abe: I joined Intel in 1985, when American manufacturers were in right in the middle of this struggle. Under those circumstances, Intel chose to abandon memory chips and specialize in microprocessors. As the term "Intel architecture" shows, our greatest strength is that Intel produces all products in-house to meet the market's needs, from silicon to architecture, software, and packages. Going forward, Intel will continue to exist as an "integrated device manufacturer (IDM)".

The major reason for this is that Intel has a strong corporate culture. The corporate culture left to us by

Gordon Moore and Robert Noyce, both founders of Intel, and Andrew Grove, who joined the company later, still remains Intel's ethos. This corporate culture is called the "Six Values" (see the Column), and it's no exaggeration to say that they're our most vital assets. Our operations are global; we have plants located in America and Europe etc. and downstream processes in Asia, and we have people of various nationalities and ethnic backgrounds engaged in these operations. Our people speak different languages and believe in different religions, but we find shared values as we had work together, and this is what the Six Values mean.

Another strong point is our contribution to society. The greatest reason the PC business has achieved such growth (in turn allowing Intel to contribute to society) is that we made our horizontal division of labor model known worldwide.

The 1960s and 1970s were the era of mainframes (large, general-purpose computers). During that period, all products—from processors and boards to operating and other systems and applications—were covered by single companies. In the 1980s, with the emergence of PCs, companies shifted to a horizontal division of labor. This allowed companies in various areas of expertise to get into the PC business. Open platforms prompted manufacturers to incorporate a whole range of innovations into PCs, and this in turn added more value to PCs. This could never have happened if Intel had been going at it alone, as we had been doing before the 1970s. This expansion of the field would also be one of Intel's social contributions.

Intel's "Copy Exactly" Method Contributes to the Huge PC Market

Obinata: When Intel manufactured memory chips, PC manufacturers would seek an alternative source of supply. Intel's memory chips could be replaced with chips made by other companies, so if they didn't need Intel memory chips any longer, PC manufacturers eventually went to suppliers that offered lower prices. This kind of experience pushed Intel toward specializing in microprocessors, where PC manufacturers couldn't seek alternative sources of supply. At the same time, this specialization enabled Intel to establish the world's highest level of production technology and build up sufficient production capacity. The result, as I read somewhere, was that Intel achieved tremendous success with its microprocessors.

Abe: That's right. That kind of "What should we do, what should we not" decision is fascinating, isn't it? In order to survive in the competition, businesses must have core competencies, which give them a competitive advantage.

At Intel, our strengths lie in the area of microprocessors, and this leads to the development of not just PC manufacturers and end users, but also to the development of society as a whole. We leave other areas to businesses that can show their stuff in those areas, rather than trying to cover the entire spectrum on our own. So, we contribute to society both directly and indirectly. On the other hand, our social responsibilities are heavy and broad-ranging.

To meet this heavy social responsibility, we have a business philosophy called "Copy Exactly", which applies to the vertical start-up of plants. I think Intel's the only manufacturer in the world that applies this principle. We have a plant in Oregon that develops next-generation processes. This plant aims to establish production technology for mass production, like manufacturing processes and procedures and production equipment. The production technology and equipment created at this plant are "copied exactly" to provide other plants with production technology and equipment for full-scale mass production, thus contributing to supply the huge PC market. Establishing this business model in the true sense means meeting the social responsibilities of Intel as a business.

[Column]

The Roots of the Six Values

The origin of Intel's corporate culture, known as the "Six Values," dates back to the "Eleven Values" set out in 1974. In addition to "Discipline", "Risk tracking", and "Results orientation", all of which have been handed down even to the present day, values such as "Openness" and "Problem solving", which represent the management philosophy of those days, still live on in the minds of Intel's employees today. "Quality" and "Customer orientation", both included in the current Six Values, were learned from Japanese companies' superior manufacturing-control methods.

Intel's Management Has Made the Right Decisions at Critical Business Turning Points

Obinata: Intel must have experienced several critical turning points in the past, but how did the company get through them?

Abe: I have three answers to your question. One concerns the shift from memory chips to the microprocessor business in 1985. Intel was indeed at a strategic inflection point (SIP) in that year. Any business grows from infancy, and without exception it reaches a period when its growth stops. We were being basically driven to the wall. Under those circumstances, Intel's management made the decision on whether we should keep producing memory chips or stop.

The PC market at the time was small, so shifting to microprocessors alone involved considerably high risks. Some of the top managers were of the opinion that we should stay in the memory-chip business, but in the end, the management decided to shift to microprocessors. If they'd had decided to just stick it out with memory chips, Intel would probably not have become what it is today.

Dr. **Tsuyoshi Abe**

Director and Senior Executive Officer, Vice President
Genenral Manager of Technology & Manufacturing Group Japan, Itel K.K.

1985	Graduated from Kinki University, Dept. of Engineering, Electrical Engineering course.
1985	Joined Intel Japan K.K.*, and has held various management positions in microprocessor system development, system support for embedded board computers, engineering training, and application engineering for PC, server, and embedded application.
1999	Became PR manager and served as a spokesperson representing Intel K.K.
2002	Named General Manager of Intel Architecture Technology Group, Intel K.K.
July 2005	Named General Manager of Marketing Headquarters, Intel K.K.
May 2007	Named General Manager of Technology & Manufacturing Group, Intel K.K.
April 2009	Named Director and General Manager of Technology & Manufacturing Group, Intel K.K.
May 2011	Named Director and Vice President, General Manager of Technology & Manufacturing Group, Intel K.K.
Oct 2012	Named Director and Senior Executive Officer, Vice President, and General Manager of Technology & Manufacturing Group, Intel K.K.

Completed studies in Management of Technology at Graduate School of Engineering Management, Shibaura Institute of Technology in March 2007

* Feb., 1997 Intel Japan K.K. was renamed to Intel K.K.

The second turning point came after the year 2000 passed. In 2001 and 2002, the semiconductor industry experienced a serious depression.

In 2001, when the "dotcom bubble" burst, the semiconductor industry was in a recessionary phase. What Intel did at that time was to make huge investments (including research and development costs) representing 40% of its sales in those days.

Obinata: That was remarkable.

Abe: We were pretty heavily ridiculed because we spent funds amounting to 40% of our sales on investments. One critic said, "Intel is betting $10 billion on a gamble". In a way that's characteristic of Intel, we were convinced that the economic slump would end someday and that it was time to prepare for the next boom.

During periods of economic downturn, businesses often tend to think negative. Since Intel is a manufacturer, it's important to increase our production capacity. Intel's core competence is that we have the world's most advanced process technology and production capacity. Making large investments means increasing production capacity to prepare for the next growth in demand. The important point is not to miss opportunities. I admit I'm saying this is with the benefit of hindsight, but everything went extremely smoothly. As the economy recovered, and demand became stronger, we didn't miss out on the opportunities. We made handsome profits and obtained ample cash reserves, and this enabled us to make the next tranche of investments. A positive spiral of growth began. Investment is indispensable to Intel's growth.

Obinata: In fact, it's really hard for corporate managers to take the plunge and invest in hard times, even though they know they should.

Abe: The third crisis for us was that, in the first half of the 1990s, Intel set up the Intel Architecture Laboratory (IAL). This was a really unusual organization, a king of "central research institute", you could say. The aim was to establish platform leadership.

At that time, the PC market was growing steadily, but PC platform manufacturers spent all of their time competing fiercely with one another, only to find that even though the specifications for microprocessors were developing according to Moore's law, the peripheral equipment was failing to catch up. In other words, it was like having a V8 engine in a compact car. Even though they were producing powerful microprocessors, they couldn't convert the benefits of their products into PC end-user value. That was why Intel established IAL.

Intel developed new standards and opened them up to other manufacturers. Making them open ensured that Intel established technology leadership in the PC industry. IAL led Intel to become the leader of the PC platform industry.

In those days, this initiative was called the "Port-of-choice strategy". The question is "how to build a good port". If many good ships (people and technology) from the world over call at a port, the port becomes prosperous. Sailors (engineers) can exchange information there, making the port an even better one. That was what IAL aimed at. That strategy really took effect, but Intel made its defining specifications open to other manufacturers and didn't not charge them. This was also significant. If we'd charged, the strategy wouldn't have been so successful.

Obinata: Ordinarily, manufacturers could never be so open. All these strategies were unique to Intel, and Intel proved they'd made the right decisions.

The Spread of the Latest Terminal Equipment Expands Demand for Servers

Obinata: Recently, the focus of interest has shifted from PCs to tablet computers and smartphones, and new information-terminal equipment is attracting a lot of public attention. How do you view such world trends in terms of Intel's future business plans?

Abe: Currently, tablet computers and smartphones are driving the PC market.

In the past, it's been said about three times that PCs are hopeless. The PC market is not falling sharply; but it's bumping along at the almost same level as before. But because of the strong growth of tablet computers and smartphones, the PC market inevitably looks as if it's in trouble. In particular, Intel has an over 80% share of the PC microprocessor market, but we will of course concentrate our energies on information-terminal equipment such as tablets and smartphones as well. This represents a major change at Intel. In his recent lecture, Intel's President Brian Krzanich didn't mention PCs at all. He talked about the new terminal equipment such as the Internet of Things (IoT), smartphones and tablet computers etc.

In fact, Intel has only a small share of these markets, but if new tablet computers and smartphones are put on the market, servers sell well. For example, if 400 new smartphones appear on the market, one new server is needed for cloud computing. Some 100 new tablet computers require one new server. If the number of downstream clients such as smartphones and tablet computers increases, so does that the number of upstream servers used for cloud computing. So at Intel we're beside ourselves with delight. Every cloud has a silver lining—though for us it's more like a golden lining!

As these information terminals spread out across the market, there are 2.6 billion Internet users, including PC users, in the world today. The number is expected to grow to 3.6 billion in three years and to four billion, over half of the world population, in 2020, which is when the Tokyo Olympics will take place. Our first and foremost goal is to establish the best worldwide supply chain.

Using Intel's Twin Strengths of "Competition" and "Sharing" to Suit the Situation

Obinata: Kazuya Saito (executive officer and manager of the Research and Development planning department), who is the general manager of ULVAC's research and development unit, will join today's discussion.

Saito: I'm glad that I can join you in today's discussion. Intel established IAL and made its platforms open to other manufacturers, but specifically, please tell us what part you played in that process.

Abe: When we take a new step, we don't make the decision by ourselves. We ask two to three influential companies in the industry to join us in making a decision. This is an important procedure for us. If Intel makes a decision alone, it could lead to conflict between Intel and others. If we invite others to join us, we can get a united front going. This enables the latest technology to spread throughout the market quickly. Otherwise, technology wouldn't spread so quickly, however excellent it is.

If one creates something new, everybody feels like shifting to it immediately. The quicker the shift is, the faster its benefits are returned to the users, but it usually takes unduly long before a decision is made. Everyone is in general agreement, but it takes time to agree on specifics. We're better at developing and spreading what will become the de facto standards.

Saito: That is why it's important to adopt the opinions of others and establish platforms that lead them.

Abe: In doing so, we listen to the opinions of extremely influential companies and factor them into our standards. That's how we can develop specifications that can be used at least for ten years. Our practical approach is that all we need to do is to expand them again ten years later.

Saito: Intel really tries hard to share business profits rather than monopolize them. But since we are doing business, it's also important to put ourselves in the most advantageous position.

Abe: How should we use "competition" and "sharing" so as to suit the situation? I think Japanese businesses should take a more nuanced approach on this.

Obinata: I see. That has a whole lot of implications indeed. So, Intel keeps its corporate strengths firmly and works together with other companies, while at the same time clarifying where it competes and where it shares.

Saito: This way of thinking can be applied to joint

Hisaharu Obinata, President and CEO, ULVAC, Inc.

Company Overview (as of the end of December 2013)

Intel K.K.

Trade name: Intel K.K.
Location of Head Office: 1-1, Marunouchi 3-chome, Chiyoda-ku, Tokyo
Founded: April 28, 1976
Paid-in capital: ¥480 million
Shareholder: Intel Corp.
Representative Director & President: Makiko Eda
Business sites:
Tokyo Head Office (Kokusai Building 5th Floor, 1-1, Marunouchi 3-chome, Chiyoda-ku, Tokyo)
Tsukuba Head Office (6, Tokodai 5-chome, Tsukuba City, Ibaraki Prefecture)
and others.
Number of employees: Approx. 580
Major business lines:
Development and provision of advanced semiconductor technology and products which make people's jobs and lives more affluent. Major products include microprocessors such as the Intel Core i7 Processor, Intel Core i5 Processor, Intel Xeon Processor, and Intel Atom Processor, as well as flash-memory products.

Intel Corp.

Company name: Intel Corp.
Founded: July 18, 1968
Founders: Robert N. Noyce (Deceased)
Gordon E. Moore (Honorary Chairman of Intel Corp.)
Representative: Brian Krzanich (CEO of Intel Corp.)
Business sites: Santa Clara, California, U.S.A. (Head Office) and others
Closing month: December
Number of employees: About 107,000
Overseas offices: More than 66 countries worldwide

development projects, too. In reality, we tend to hold each other in check, and so we could achieve greater results if we could strike a balance between competition and sharing.

Providing the Latest Technology is Important. But Cost is Even More Important.

Saito: Recently, Intel has unveiled a range of wearable devices. How do you plan to develop them in the future?
Abe: The Intel Atom processor is designed for smartphones and tablet computers, but the low-power Quark processor will play a central role if the focus of production shifts to wearable devices.

The Edison is basically one whole computer in the size of an SD card. The future goal is to make it even smaller.

A silicon transistor can be made smaller, and the way to do that is to put more effort into its packaging. It could fit into a button someday. With that, it would be a wearable device in the true sense of the word.

Fab D1X, Oregon, U.S.A.

The question is not only how small wearable devices are but also what they can do for the end users, in what form of application. But Intel doesn't do operating systems or applications; we're simply a manufacturer of microprocessors. Under these circumstances, what Intel emphasizes is security. With so many people connected to it, the Internet must be an infrastructure that can be used with a sense of security. What we consider as our mission is to ensure the security of the Internet. Security's becoming important even for gadgets like smartphones and tablets. People must be able to use platforms with a sense of security.
Saito: The goal for wearable devices is to make them compact and reduce their power consumption, but what is your view of the possibility of various sensors being combined. And what about the costs involved?
Abe: We have to put more effort into achieving innovation in packaging. At the same time, cost is an issue to be addressed. Cost is an issue for all manufacturers, not just Intel. "Cost is King." I could go further. "Cost is God."

Using the World Café Method to Ensure Knowledge-sharing Among Departments

Saito: Indeed, cost management is essential.

To change the subject; to produce these results, it's also important to address administrative issues like improving the skills of individual workers. Have you figured out good ways to hand down individuals' institutional experience to the next generation?
Abe: That's a very good subject. In fact, we're also faced with the issue of "tacit knowledge versus explicit knowledge". A lot of Japanese businesses are based on tacit knowledge. The apprenticeship system encourages apprentices to learn by watching their masters and acquire skills from them. To put it differently, knowledge is less documented here. On the other hand, explicit knowledge means documentation. We're addressing the issue of how we should share tacit knowledge, though the initiative is limited to our department.

The first step is to "know each other". Since a person's knowledge is limited, people from different departments are gathered together to find out who knows what.

If you know who knows what, you can ask for the help of the person who knows when the need arises. It's important to know who knows what beyond departmental boundaries. This concept can be found in server architecture as well. Servers have a mechanism defined as transactional memory, and this is exactly what the concept means. It refers to a mapping function that shows what sources are available and where.

Obinata: An organization can't work effectively unless its employees know who can handle what and where they can be found.

Abe: In particular, there aren't so many personnel changes between departments in Japanese businesses, though it might look as if there are lots. If you're stuck in the same department from day one, there's no way you can learn what personnel are available in the larger organization. Destroying this kind of environment is one of the manager's important tasks.

In my department, I'm doing this using the World Café method. For example, I prepare five tables and have about ten people sit at each table. I give them a common subject for discussion, say, cost reductions. They discuss about cost reductions at each table. Each team expresses its opinions about cost from a different point of view. Then each team is reshuffled with some of its members replaced with people from other teams. When you change tables, your opinions are tested by the possibilities and ideas you find being put forward there. This process produces very good things, because possibilities and ideas are reviewed from a whole range of different people's perspectives. You ought to try it out.

Investment in Personnel Enables Companies and Their Personnel to Grow Continuously

Obinata: What do you do to develop human resources and raise employee morale?

Abe: I may be flattering myself, but Intel is serious about training its employees. Intel has founded a virtual university called "Intel University" within its organization. Intel University offers over 100 training courses, which can be taken by any one of our 100,000 personnel, from new employees to managers. At Intel, we call this the "LCE (learn, connect, experience) model".

The idea is to improve one's job skills to achieve one's goals by learning, being connected, and experiencing. To that end, we have the "10%, 20%, 70% rule". Learning alone achieves 10% of the entire goal. Cooperation among departments achieves another 20%. Finally, in order to really achieve the remaining 70%, you have to do it yourself (experience). So at Intel, managers pay a lot of attention to staff who've completed this training; for example, they give opportunities to their staff to soon use what they've learned.

The primary mission of a business is to keep going, but just keeping going means that you're getting 50 points out of a possible 100. You get the remaining 50 points for keeping growing. A business can't grow unless its employees grow. The ideal is to start a positive spiral of employee growth, bringing about the company's further growth, which in turns brings about further growth for the employees. If we can achieve this, we will be invincible as a company. This is directly connected to motivation. Individual employees grow with their company, and the company grows with its employees.

In the 1990s, Prof. Peter M. Senge at the Massachusetts Institute of Technology put forward his definition of "learning organizations".

He said that a business is an organization in which the individual staff members continually expand their capacity to create the results they really want; they do this by having the ability to design the organization to match the intended or desired outcomes and recognize when the initial direction of the organization is different from the desired outcomes, and they take the necessary steps to correct this mismatch. He defined the competitive advantage of a business as arising from continuous learning by both the organization and its individual members. This idea resembles Intel's culture. Investing for personnel, training them, and improving their skills develops the business as well as its employees, which leads to motivating the business and its employees to aim higher.

Obinata: This year, I'm trying to invigorate ULVAC's organization by calling on our employees to avoid being the proverbial "frog in the well that knows nothing of the great ocean". I've learned a good lesson from you. Thank you for having such a meaningful conversation with us today.

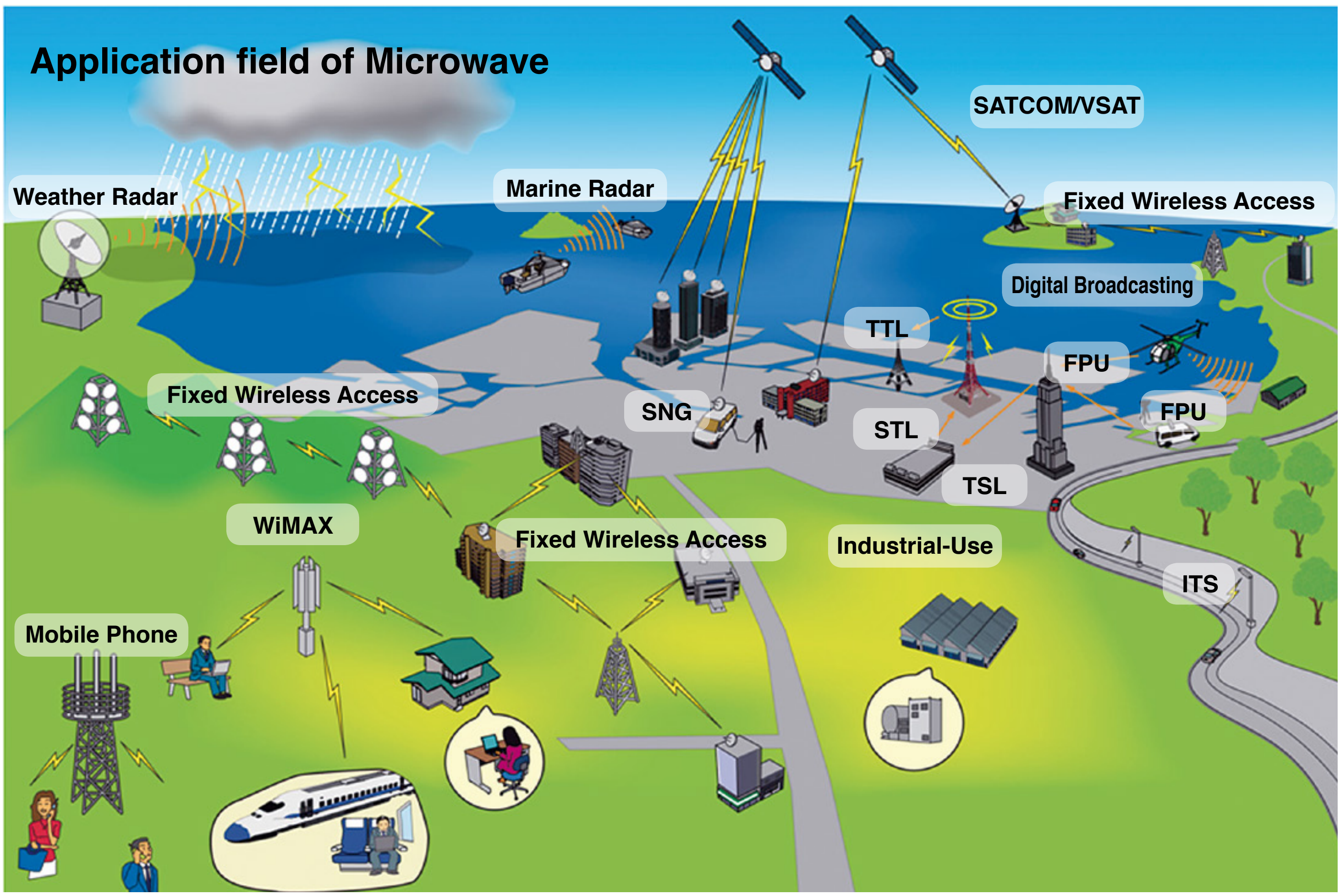
The photo shows (from left) ULVAC Executive Officer Saito, Intel Vice President Abe, and ULVAC President Obinata.

Communication Infrastructure Front Line

for Diffusion of Cellular Phones

—— Further acceleration via Development of High-performance Microwave Communication Devices

Reporting from **Toshiba Corporation Social Infrastructure Systems Company**
Microwave Solid-State Engineering Department, Komukai Complex



Data from Toshiba Corporation Social Infrastructure Systems Company

VSAT: Very Small Aperture Terminal
SATCOM: Satellite Communication
WiMAX: Worldwide Interoperability for Microwave Access
SNG: Satellite News Gathering
TTL: Transmitter to Transmitter Link
STL: Studio to Transmitter Link
TSL: Transmitter to Studio Link
FPU: Field Pickup Unit
ITS: Intelligent Transport Systems

LIVING & ULVAC

More than 1.75 billion cellular phones are manufactured annually worldwide (2012 survey by Gartner, Inc.), and 94.5% of households in Japan have one or more cellular phones (2012 survey by the Ministry of Internal Affairs and Communications). In particular, it would be no exaggeration to say that almost everyone in their twenties and almost all university students have a cellular phone. In addition, it may be safely said that today, a cellular phone is also a must-have item for elderly people. Originally, wireless communication was achieved with wireless communication equipment that made use of short wave radio frequencies to connect two parties directly. Wireless communication via cellular phones is significantly different from wireless communication of the past in that cellular phones connect two communicating parties via communication stations, which are connected via a wired communication network. In other words, communication via cellular phones is achieved by combining the best features of two different communication systems: mobile “wireless communication” and networked “wired communication”. This issue of LIVING & ULVAC deals with the history and communication infrastructure of cellular phones, which have become a household item on a global scale, and focuses on the latest trends in microwave communication devices that play an essential role in that infrastructure.

Cellular Phone Market Reaching Global Scale As the Spread of Cellular Phones Continues

In Japan, the diffusion rate of cellular phones has been surveyed by two different approaches. The Cabinet Office has conducted surveys on households consisting of two or more family members, whereas the Ministry of Internal Affairs and Communications (MIC) has conducted surveys on all households including single-person households. The MIC has been compiling statistics on this diffusion rate since 1993. According to the figures released by the MIC, the diffusion rate, which was only 3.2% in 1993, reached more than 94% in just 10 years. For details, refer to **Figure 1**.

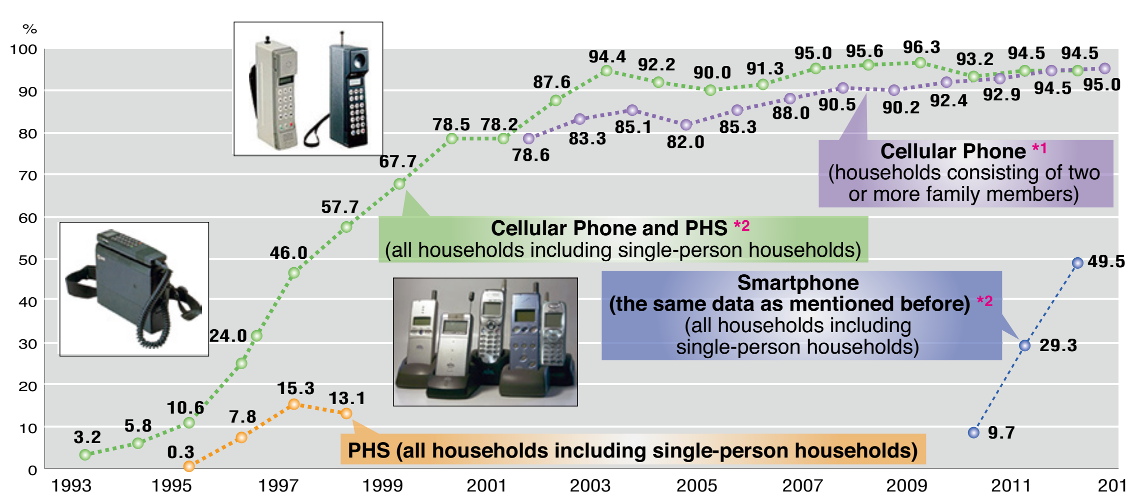
Before cellular phones made their market debut, large zone schemes, such as the scheme for wireless communication in taxis, were the main type of wireless communication. In large zone scheme wireless communication, each communication station covers a zone approximately 60 km in diameter. In this scheme, two users have to be in the same zone using the same communication service in order to communicate. On the other hand, the system for cellular phone communication consists of small zones approximately 6 km in diameter. The small zone is called a cell; this is where the name cellular phone comes from. The cellular communication system is characterized by the fact that the same radio wave frequencies can be used again and again without radio interference within each cell. Accordingly, this system is able to provide a large communication capacity even with the limited frequency resources that are available. The fact that a large number of users are able to communicate with each other on cellular phones at the same time is largely due to this technology.

High-performance Cellular Phones Contribute to Widespread Use

The world’s first mobile communication based on the cellular communication system was started in 1979 by Nippon Telegraph and Telephone Public Corporation (NTT; current NTT DOCOMO, INC.). NTT provided car-phone service using the 900 MHz band. The size of the radio set was 6,600 cc (slightly less than seven 1 L PET bottles). Needless to say, it was impossible to hold it by hand. Accordingly, the radio set was installed in the trunk with the antenna attached to the roof. It cost 200,000 yen as a deposit, 30,000 yen for the basic monthly service fee, and 10 yen for every six seconds of use.

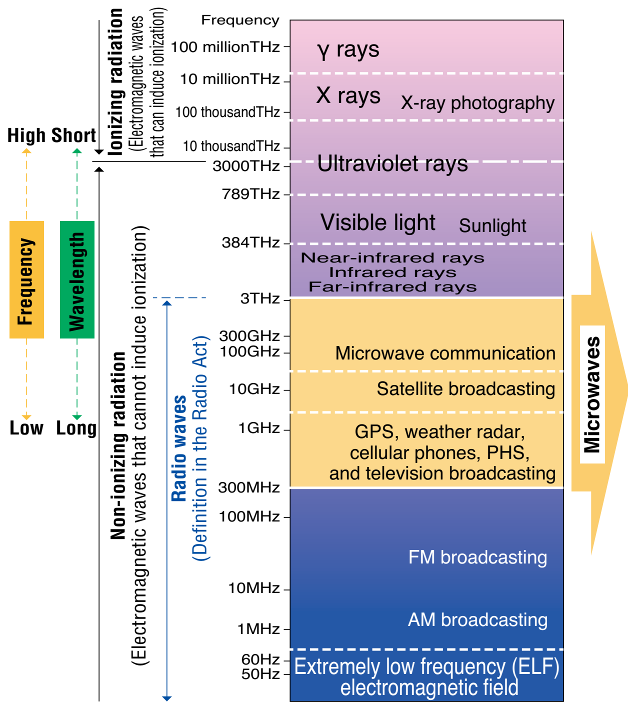
In 1985, a portable terminal approximately 3,000 g in weight, a so-called “shoulder phone”, was developed. In 1987, the volume of a radio set became 500 cc (equivalent to the volume of one 500 mL PET bottle), and its weight became 900 g. In 1989, a foreign affiliated company developed a new device 220 cc in volume and 303 g in weight, amazing the world. It can be said that this device is the world’s first handheld cellular phone. Thus, a new era of tough competition for realizing smaller and lighter cellular phones was inaugurated.

The next year, in 1990, a cellular phone 203 cc in volume and 293 g in weight was released. Subsequently, competition to shave off



[Data]
*1: Target households are general households except single-person households and households of foreigners (data as of March; according to a “Consumption Trend Survey” conducted by the Cabinet Office).
*2: Target households are all households including single-person households. Smartphones are also included (for 1998 and earlier, the diffusion rates are only of cellular phones; data as of the end of the year; according to a “Communications Usage Trend Survey of Households” conducted by the Information and Communications Policy Bureau, MIC).

Figure 1. Change in diffusion rate of household cellular phones



Created by ULVAC based on “Radio Waves in Life” published by the Association of Radio Industries and Businesses

IEE’s classification of microwaves according to frequency and their applications

Band	Band frequency (GHz)	Application
W band	75 to 111	Radio astronomy
V band	40 to 75	Radar and communication satellites
Ka band	26 to 40	Communication satellites
K band	18 to 26	Communication satellites
Ku band	12 to 18	Satellite television broadcasting and satellite communication
X band	8 to 12	Military communication, weather satellites, earth observation satellites, navigation radar, surface search radar, air search radar, and fire control radar
C band	4 to 8	Satellite communication, fixed wireless systems, wireless access, surface search radar, and air search radar
S band	2 to 4	Fixed wireless systems, mobile digital satellite broadcasting, ISM band (microwave ovens, wireless LAN, WIDESTAR satellite phones, amateur radio, etc.), navigation radar, and air search radar
L band	0.5 to 1.5	Television broadcasting, cellular phones, Inmarsat satellite phones, 800 MHz band, and air search radar
P band	0.25 to 0.5	Mobile communication, analog cordless phones, and specified low power radio
G band	0.2 to 0.25	Military aeronautical radio
I band	0.2 or lower	

IEE: The Institute of Electronics Engineers, Inc.

Figure 2. Outline of classification of electromagnetic waves according to frequency and frequencies of microwaves

even 1 g or 1 cc continued for years, and new models were released once or twice a year. In 1999, the weight was reduced to as little as 57 g for the second generation digital cellular phones.

At that time, competition for developing new cellular phones started to make a transition from miniaturization to the development of multifunction cellular phones. In 1999, NTT DOCOMO, INC. started the i-mode service, and consequently, cellular phones underwent an enormous transformation from simple voice phones to information terminals that also provide a mail communication function and a browser function. Subsequently, new convenient features, such as large liquid crystal displays, camera functions, ability to use external memory, GPS, wireless LAN, and one-segment broadcast reception, were added to cellular phones one after another. As a result, the size of the phones themselves became larger, but the miniaturization on the inside was never brought to an end. This internal miniaturization led the competition onto a new stage of competing to incorporate as many new functions into the available internal space as possible.

In 2001, the third generation cellular phone service started for high-speed large-capacity communication. New radio frequencies and a new communication system were adopted for this service, and consequently, microwave communication devices that had not been used before made their debut.

After the year 2000, the number of cellular phone users rapidly increased worldwide where it had been limited to Japan, Korea, and major Western countries before that. Against this backdrop, various technological innovations for the communication infrastructure kept its development moving forward. For example, multi-band cellular phones that could automatically select a vacant frequency band to use from among multiple frequency bands, and multi-mode cellular phones that could be used in any communication system anywhere in the world.

In 2007, Apple Inc. released the iPhone which inaugurated the era of smartphones. Subsequently, in 2010, Apple Inc. released iPad and broke new ground of tablet PCs by adding a cellular phone function. Thus, the communication infrastructure for cellular phones has been increasing in importance.

We have looked at the history of the advancement cellular phone terminals. Next, let’s look at microwave communication technology, which plays an important role in communication infrastructures.

Microwave Technology Essential for the Infrastructure of Cellular Phone Communication

Radio waves are classified according to their frequencies. Microwaves are one type of radio wave. They occupy the shortest wavelength region of the radio wave spectrum. They are radio waves (electromagnetic waves) with wavelengths ranging from 100 μm to 1 m and frequencies ranging from 300 MHz to 3 THz. This region includes decimeter waves (UHF), centimeter waves (SHF), millimeter waves (EHF), and submillimeter waves. For details, refer to **Figure 2**.

Microwaves are oscillated by using circuits containing a device such as a magnetron, Klystron, traveling-wave tube (TWT), gyrotron, and Gunn diode. Generally, the oscillated microwaves are propagated through coaxial cables when they are not propagated through the air as radio waves via an antenna. However, for microwaves with high energy (high electric power or high wattage), a metal guide is used to propagate them. In recent years, transmitters integrating semiconductor devices with lines, such as microstrip lines, have been increasingly used as the mainstream means to propagate microwaves.

Microwaves have found widespread application in various areas, such as satellite television broadcasting, microwave communication, radar, microwave plasma, microwave heating (microwave ovens used in general households), microwave treatment, microwave spectroscopy, microwave chemistry, and microwave electric power transmission. Microwaves are also used in unexpected applications. The sensors attached to urinals for automatic flushing are microwave sensors.

Thus, cellular-phone wireless communication technology using microwaves and millimeter waves serves to make our lives more convenient. These conveniences have been realized with the aid of various new microwave communication devices that have been put into practical use.

A marvelous energy transmission method known as wireless electric power transmission has been devised as a future application of microwaves. It is said that the realization of this method of power transmission will eliminate the necessity of using different cables to send information and electric power separately and will allow us to send them through one wireless channel together.

High Expectations for GaN in New Microwave Communication Devices

Microwave communication is achieved with the aid of microwave communication devices containing semiconductors. One such semiconductor is GaN (gallium nitride). It has been thought that it would be difficult to put GaN into practical use. However, GaN and GaAs (gallium arsenide) are now expected to play an important role in microwave communication devices. GaN's characteristics make it a suitable material for producing high-power transistors for amplifying microwave signals.

We interviewed Toshiba Corporation Social Infrastructure Systems Company (Microwave Solid-State Engineering Department, Komukai Complex). This company has been developing microwave communication devices with their high technical capabilities and reliability in the area of compound semiconductors since the 1970s. They started development before cellular phones made their market debut.

In the past, microwave communication found application only in cutting-edge technologies such as space development and the defense industry. In recent years, however, it has been increasingly adopted in various areas, such as air traffic control radars, satellite communication base stations, and medical equipment. In Toshiba Corporation Social Infrastructure Systems Company, microwave communication is used in particularly widespread areas, such as weather radars for providing more detailed weather forecasts and broadcast relay devices that can transmit large quantities of images in real time.

In these areas, devices such as electronic tubes, which include magnetrons, Klystrons, and TWTs; FETs (field effect transistors) made of GaAs; and LDMOS (lateral double-diffused MOS) transistors made of silicon materials have been conventionally used. High-frequency, high-power GaN transistors have several advantages over these conventional devices in various respects. However, their high prices prevented them from finding widespread application, being adopted only in limited application areas. At present, thanks to technological innovations, GaN transistors have declined in price. In addition, various GaN transistor types supporting different frequency bands and providing different levels of output power have been developed. As a result, they find application in increasingly wide areas.

"Our major products include trunk communication base stations and satellite communication stations. We specialize in high-frequency, high-power devices for microwave communication. Our shipment of GaN high-frequency devices has been steadily increasing since we started the shipment in the first half of the 2000s", says Mr. Hideki Kimura, the technical group leader of the Microwave Solid-State Engineering Department, Toshiba Corporation Social Infrastructure Systems Company.

Mr. Kimura continues, "Although high-frequency GaN transistors are high-cost products, their excellent physical properties as semiconductors allow them to take the place of conventional devices. We will make full use of their features brought by their miniaturization, high power, and high efficiency. We will thus be able to contribute to the construction of social infrastructure systems".

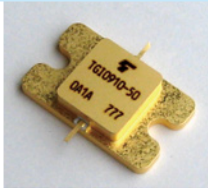
Price Reduction and Higher Performance The Potential of GaN Devices

GaN has a wider band gap than GaAs does. The wider band gap is advantageous to us in that GaN devices can be operated at higher voltages while ensuring reliability. High-voltage operation, which allows transistors to have high input-output impedance, is convenient for ensuring linearity. Consequently, distortion generated in their operation as amplifiers can be reduced. The wide band gap also allows GaN devices to operate at temperatures as high as 300°C. Therefore, structural components used for the cooling and heat-radiation of GaN devices can be simplified. This fact suggests that use of GaN devices will contribute to the miniaturization and cost reduction of equipment.

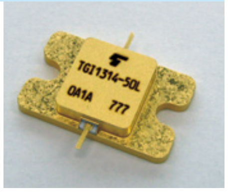
Toshiba Corporation Social Infrastructure Systems Company has commercialized high-power devices that can be used for various frequency bands including C band (4 GHz to 8 GHz), X band (8 GHz to 12 GHz), and Ku band (12 GHz to 18 GHz). According to Mr. Kimura, they will develop higher power, higher efficiency devices delivering higher performance. In this way they will contribute to the development of industry and the construction of the communication infrastructure, leading to a more convenient lifestyle.

Microwave communication devices (GaN devices) produced by Toshiba Corporation Social Infrastructure Systems Company

C-band GaN (120 W)



X-band GaN (50 W)



Ku-band GaN (50W)

Introduction: Origin and Technological Development of MEMS

MEMS (Micro Electro Mechanical Systems) generally refers to ultra-tiny machines on the micron scale (1/1,000 millimeters) and this field is also sometimes called "micro mechatronics" or "micromachines".

The first person who mentioned the great potential of MEMS is Richard P. Feynman a prof. at California Institute of Technology and who also jointly received the Nobel Prize in Physics along with Shinichiro Tomonaga in 1965 for his contribution to progress in the field of quantum electrodynamics. In a lecture called "There's plenty of room at the bottom" held at the university in 1959, he made ten proposals about the potential of the nanoscale world.

There is an interesting episode about Feynman. He announced he would offer a $1,000 prize to anyone who could make a micromotor with a diameter of 1/64th of an inch (approx. 4 millimeters). It was easily realized by an engineer in 1960 the year following the lecture, and to whom the prof. paid the prize money.

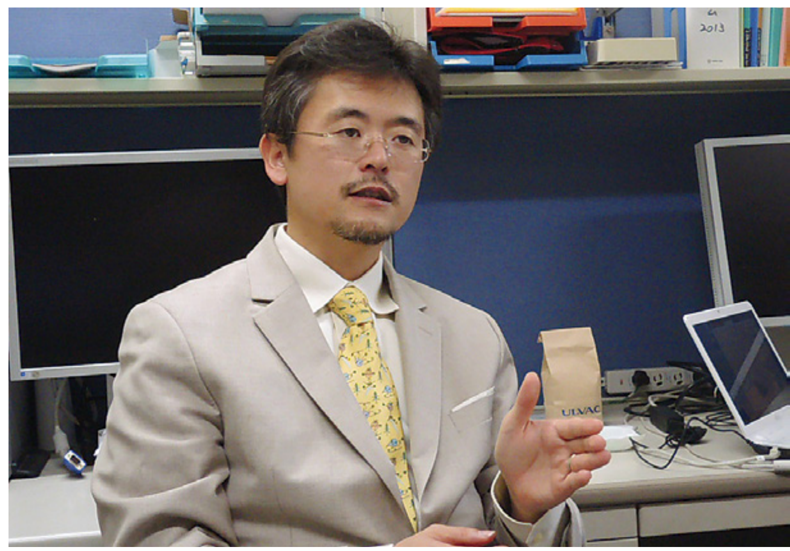
It is an undoubtable fact that this opens up new unexplored field of MEMS.

In the 1970s and 1980s, much technological progress was made in MEMS while widening its applicability to fields such as semiconductor pressure sensors and movable mirror arrays.

As motors similar to the micromotor for which Feynman offered prizes, Prof. Y. Tai from the University of California, developed a micromotor using metal and silicon thin films in 1989 while a Japanese research group led by Prof. Hiroyuki Fujita

Dr. Yoshio Mita

Dr. Mita was born in Kure City, Hiroshima in 1972. After graduating from the Department of Electronic Engineering at the University of Tokyo in 1995, he completed his master's course and the doctoral course (received a PhD in Engineering) respectively at the University of Tokyo in 1997 and 2000. From September 1997 to September 1998, he worked at the Institute of Electronics, Microelectronics and Nanotechnology (IEMN/ISEN) as an associate researcher at the National Centre for Scientific Research of France. His research achievement during his stint at the research institute was "A MEMS-Oriented Distributed Processor for Integrated Feed-Back Controller" which gained him the Yasujiro Niwa Outstanding Paper Award in February 2000. In April 2000, he became an assistant researcher at the VLSI Design and Education Center (VDEC) where he developed an efficient support system for open devices managed by the VDEC and achieved stable system operation. In April 2001, he became a lecturer at the Department of Electrical Engineering in the School of Engineering of the University of Tokyo, where he researched microsystems for integration with micro fabrication technologies,including intellectual VLSI, self-aligning peak fabrication technology, nano ridge fabrication technology, self-aligning rhombic micromirror fabrication technology, and microfabrication technology. Since April 2005, while serving as an associate prof. in the department, he has been conducting research in various fields ranging from nanofabrication technology and LSI integration technology to application systems at the Takeda Sentanchi Building.



Associate Professor, Department of Electrical Engineering, School of Engineering, The University of Tokyo
Affiliated Professor to the VLSI Design and Education Center (VDEC)
Manager of the Microfabrication Platform Project in the Nanotechnology Platform Project
Dr. **Yoshio Mita**

Future Dream

To Make a Toy Problem Come True

—Fostering Future Researchers and Make Technological Progress for the Future through MEMS Development

Unlike the times of Edison, progress in science can no longer be achieved by a single scientist. In modern science, research projects are interdisciplinary, pressuring researchers to get results as early as possible. This is also true of development of MEMS (Micro Electro Mechanical Systems) which can be applied to an increasing number of fields. Dr. Yoshio Mita, Associate Prof. at the University of Tokyo is involved not only in research and development of MEMS, but also in development of next-generation researchers and management of industry-government-academia projects. In this issue's Vision, we asked Dr. Mita about promising MEMS technology as well as teaching methods to ensure further progress in this technology as well as his views on the qualities and mindset required for researchers.

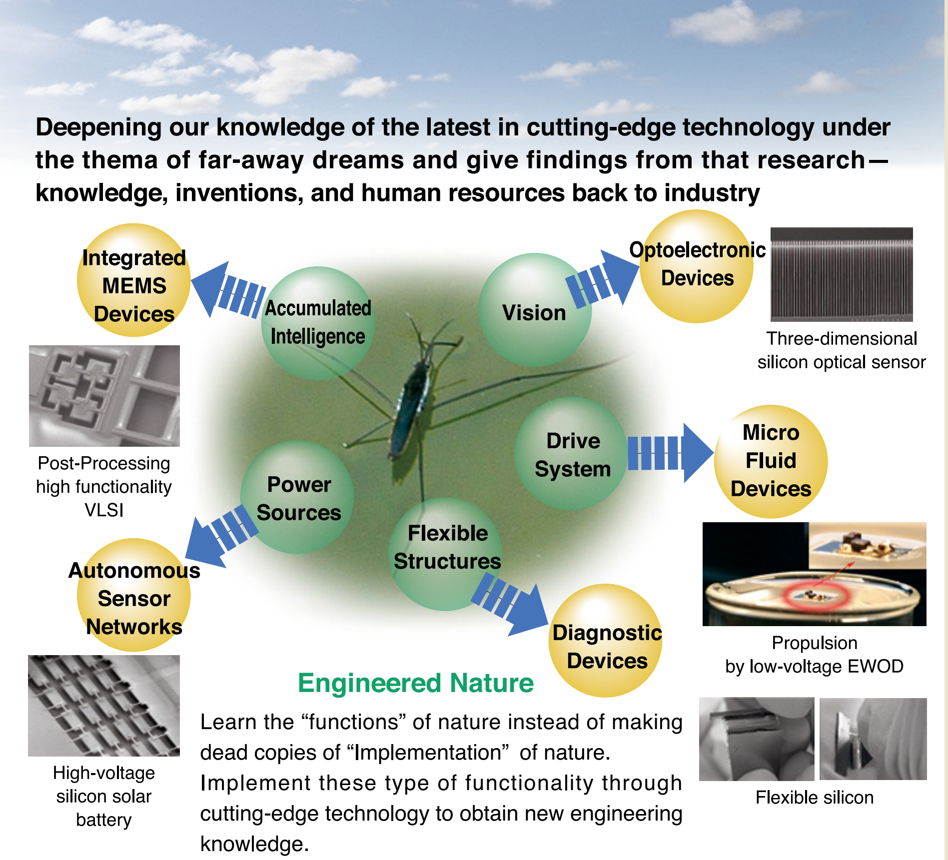


Figure 1. University-Centered Linear Model for the 21st Century

Photograph of a self-propelled microrobot powered by electricity that is transmitted by electromagnetic resonance (pond-skater robot) (above). Photograph of a pond-skater (below).

at the Institute of Industrial Science, The University of Tokyo, developed an electrostatic rotary motor in 1987 and an electrostatic nickel-plated micromotor in 1991. These motors used semiconductor processes such as thin-film deposition, pattern formation (photolithography) and etching which have become mainstream technologies since then. Prof. Fujita is still active as a leading Japanese MEMS researcher who taught and greatly influenced Prof. Yoshio Mita, the guest of this issue.

Deep Etching Technology Contributing to the Three-dimensional Structure of MEMS

Mita: Prof. Fujita is my respected teacher in MEMS.

After completing my graduation research into parameter extraction methods for MOSFET devices at the laboratory of Koichiro Hoh (grandson of Hidetaro Hoh, who is famous for the Hoh-Thevenin's theorem), I researched smart micromachines containing integrated circuits (Smart MEMS) under Prof. Fujita's guidance in my master's and doctor's programs. In this research, I proposed a sensor, processor, and actuator integrated system concept together with related fabrication technologies such as silicon shadow mask direct fine-patterring with self-alignment capability and micro optical integration system.

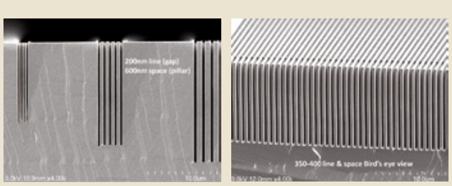
MEMS technology is continuously making progress. Surface micromachining, which processes thin films into structures two-dimensionally was prevalent in the early days, but progress in silicon deep etching using ICP-RIE (Inductive Coupled Plasma-Reactive Ion Etching) and wafer bonding process technology has now made it possible to fabricate sophisticated, complex, three-dimensional structures. This technological progress has contributed greatly to the progress of MEMS. Microfabrication including deep etching is also one of my specialties.

When I started my postgraduate research in the new laboratory, I suffered from differences in the research environment. At that time, I was feeling cocky just because my graduation thesis based merely on a little personal inspiration, was adopted for an oral presentation at an international conference. Since I have always liked electronic work, I was confident of being skillful with my hands. When I tried to make a micromachine myself, however, I lost confidence. I couldn't do as well as my seniors, even though we used the same devices and process. I kept thinking "why" everyday.

It was around the end of my second year in the doctoral course when I was finally able to to design a process just as I wanted and make a satisfactory micromachine according to the process without errors. It is due to this experience that I advise my students to be patient because it takes at least four years for them to do things just the way they really want (so they should not give up and should continue with their doctoral course studies).

Development of a Pond-Skater Robot Leading to Future Technological Progress in MEMS

MEMS technology is essential to the manufacturing of small high-performance electronic devices typified by sensors, printer heads, gyroscopes and projectors used in cars, optical devices, communications devices, and other manufacturing devices. MEMS which is now more integrated and composite, is used for developing multi-functional electronic devices. The future is thought likely to provide technology combining nanotechnology with biotechnology and the size of the MEMS market is estimated to grow



Deep etching technology contributing to the three-dimensional structure of MEMS

This is a set of demonstration lecture tools for "the study of electronic information devices". Dr. Mita makes it his motto to to appeal directly to the students' intuition by using self-madedevices.

Dr. Mita with his laboratory students

from about 7.1 billion US dollars in 2010 to 11.3 billion US dollars by 2015.

Mita: I have been working to develop a pond-skater robot as one of my "toy (future dream)" projects. It may just be a "toy", but it is a toy for the distant future. I believe that the more distant is the better.

When I studied at the University of Edinburgh in the U.K. in May 2007, I started researching towards a small, autonomous, self-propelled electronic device capable of running on water or to put it plainly, a pond-skater robot.

This kind of research drawing inspiration from living creatures was being conducted by many researchers in their own particular fields, but I thought a sub-centimeter device capable of running on water under its own power would be the first of its kind in the world. In fact, there are other researchers researching similar robots around the world. I felt relieved and motivated by finding that these researchers also face technological challenges similar to mine.

A permanent mission for researchers is exploring a field untrodden by others. It is my research style to focus on dream-like applications. The world's first novel approach involves various technological challenges. Overcoming these challenges requires making serious engineering efforts. If we succeed in these efforts, we can obtain advanced technology which can be readily applied to diverse fields. I call this particular system a university-centered linear model for the 21st century (Figure 1).

Future Development of MEMS Requires Fostering Future Researchers

MEMS will be used in a wide range of industries. Research and development of MEMS involves more than just one academic discipline so universities can do more in the field of MEMS. Universities should also play a major role in fostering MEMS researchers.

Mita: While working as a researcher, I teach students at the UTokyo Hongo campus. If my left hand is for research, then my right hand is for education. I'm also responsible for the microfabrication project of the University of Tokyo in the Nanotechnology Platform Project led by the Ministry of Education. I feel like I manage the project with my "feet". With my hand and feet always bound, I just want to keep my brain running free.

As an educator, I think it is important to give my students in the style that anyone can understand.I bring self-made teaching materials to my classes on electronic information devices and do experiments with

Microfabrication Platform Project as a Nanotechnology Platform Project of the Ministry of Science and Technology

The University of Tokyo participates in the Nanotechnology Platform Project. Among the three areas of this project, the VLSI Design and Education Center (VDEC) undertakes the microfabrication platform project while the Nano-Engineering Research Center of the Institute of Engineering Innovation handles the microstructure analysis platform project. The University provides the VDEC with total support in close cooperation with the Nano-Engineering Research Center. The main features of this support are a super clean room ranked as Federal Standard Class 1 in the Takeda Sentanchi Building of the Asano campus and virtually the only electron beam drawing device in the world which is capable of drawing microstructures directly and speedily on a broad range of wafers ranging from wafer chips to 8-inch wafers. This well-equipped research environment enables researchers to handle valuable devices with their own hands. The University provides a system which allows researchers to easily create intelligent MEMS integrated with electronic circuits while supporting the original mission of VDES which is assisting in the trial manufacture of VLSI.

● Contact:
Microstructure Platform Support Office of the Nanotechnology Platform Project, the University of Tokyo
Room 301, Takeda Sentanchi Building (Asano campus of the University of Tokyo)
2-11-16, Yayoi, Bunkyo-ku, Tokyo 113-0032
Tel: 03-5841-1506
Email: nanotech@sogo.t.u-tokyo.ac.jp

Super clean room of Federal Standard Class 1 In January 2014, "F7000S-VD02"a new ultra high-speed electron beam drawing device was installed here.

CE-300I, a nanotechnology assistance system manufactured by ULVAC (owned by the laboratory of Satoshi Yamamoto at the Faculty of Science)

these teaching materials in front of students. As my students seem to like this style of teaching, I received the first “Best Teaching Award of the Faculty of Engineering, the University of Tokyo” this year.

I often encourage my laboratory students, saying: “You should first complete any project by yourself. It can be just a toy ploblem (future dream). By doing this you will learn a lot. If you face any problems, Don’t worry, I will help you.”

The largest difference between Japanese and French researchers I noticed when I was in France for study is that French researchers are without doubt descendants of Descartes. They first doubt what others say. They don’t trust others in the first place. They build their logic based on only what they can trust.

I was surprised by their pragmatic approach. This approach is effective in fostering experts yet limits their interest in their own fields. This is a kind of division of work like a player’s position in rugby. On the other hand, Japanese researchers work like kendo players in a team competition. It’s a team competition, but the players compete one by one. This is the Japanese style.

The philosophy of my laboratory consists of the best parts of the European style and the Japanese style. I want to develop “specialist” researchers who specialize in a certain field, as well as “ace” researchers, who are familiar with many fields. This is my ideal approach.

To accomplish this ideal, I try not to give answers to students straightaway. While I might tell high school students or younger students to do something according to a given method, I tell university students to do something according to a method that they came up with on their own. A method is an established approach with which anyone can produce the same results. It is more important for students to discover and master their own method.

Persistence Will Pay Off. Every Failure is a Stepping Stone to Success.

Prof. Hiroyuki Fujita, a pioneer of MEMS in Japan, claims that three essential qualities of MEMS can be described with three M’s or namely Micro, Mass production and Multifunction.

With these three qualities in mind, we can say the MEMS industry will grow to produce MEMS devices on a size scale from 1 nanometer to 10 micrometers. In the world of nanometers, if we could manipulate atoms and molecules as if by gene manipulation, then we could also apply MEMS to the medical and bioscience sector and many other sectors.

Mita: Academic disciplines related to MEMS research will keep expanding. What a single researcher can do on their own is limited. The Takeda Sentanchi Building of the University of Tokyo puts up a slogan “one step by one thousand researchers.” This slogan means if each of 1,000 researchers takes just one step, then they take a total of 1,000 steps altogether. At present, 500 researchers use the clean room, so we are just halfway to that goal.

To achieve this goal, I need to have a closer relationship with university and corporate researchers. I hope corporate researchers will come back to university to feel refreshed and inspired and then bring back what they learned and use it as the core of new business. University research facilities should be filled with researchers who make continuous technological progress.

The books shown on the right are French comics titled “Les Shadocks”, which are well known by all French. The main character is foolishly honest. He attempts an experiment which only has a one-in-a-million chance of success for example by performing one million experiments. He believes that even if he fails 999,999 times, he will succeed in his last attempt. He is in fact ridiculed in the comics, but I believe this is where the truth of science lies—patience pays off. The more failures you experience, the more chances of success you have. You cannot succeed if you repeat failures aimlessly. Only if you reflect on your failures will you be able to find a new approach. This also applies to MEMS research. It is true that every failure is a stepping stone to success.

I’m working to achieve integrated MEMS through my research on pond-skater robots. I want to share the findings of my research with others rather than keep them secret. To achieve “more than Moore” (progress of electronic devices through functional diversification), researchers from different fields should gather together to create new technologies by combining various technologies.

Les Shadocks, a bestseller series in France

Postscript to the Interview (Editorial Room)

Childhood Episodes

What came to my mind after the interview is the qualities of researchers. I didn’t cover this in the article, but Associate Prof. Mita gave us some childhood episodes.

“I always worked to create something if I had free time”, said Dr. Mita. “I liked to design something from zero. Every day I drew whatever I envisaged on paper, such as dreamlike machines. Influenced by a biographical comic about Edison, the king of inventors, I decided I wanted to become a scientist.”

I was surprised by a picture drawn by Dr. Mita at his graduation from kindergarten (see the photo on the right) and his notes added to the picture. The picture depicts himself doing something in a laboratory. The notes say: “I want to become a scientist because I can do research, invent things, and earn a lot of money. I have to work hard to become a scientist, so I want to go on to graduate school...”

Most of us cannot make our childhood dreams come true, but Dr. Mita succeeded. Edison once said, “Even a superhuman genius is not superhuman. I’m just a genius in not giving up.” In line with this remark, Dr. Mita owes his success as a scientist to his continued persistent efforts. I think we can say the same about MEMS research. Edison also said, “Any progress and any success all begin with thinking.”

Leading Company for Contract Production of Sterile Products

Toyama 2nd Plant of Fuji Yakuhin Co., Ltd.

(750, Itakura, Fuchu-machi, Toyama City, Toyama Prefecture)

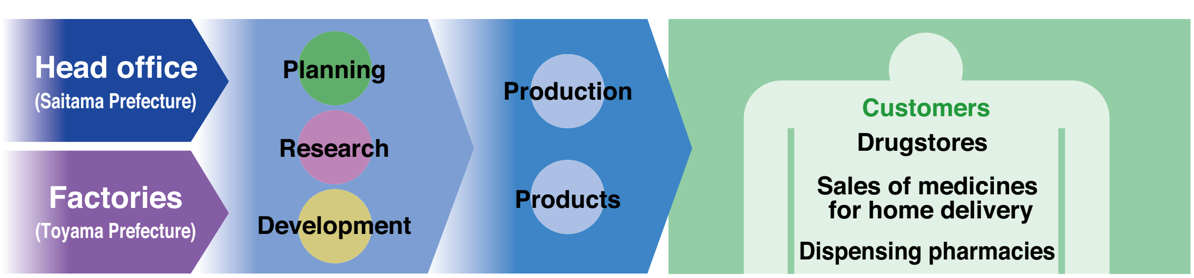
An Outstanding Company in Terms of Consistent and Detailed Services in Processes Ranging from Clinical Testing of Sterile Products through to Sales


Toyama 2nd Plant of Fuji Yakuhin Co., Ltd.


Toyama 2nd Plant of Fuji Yakuhin Co., Ltd.

The system of oki-gusuri (sales of medicines direct to the home) started 300 or more years ago in Toyama Prefecture. Fuji Yakuhin Co., Ltd. was founded in 1930 and served as the start for traditional sales of medicines for home delivery as a corporate business in Toyama Prefecture. This company, which established a consistent system from research and development through to production and sales, is a complex pharmaceutical company that also holds the top share in the industry of home delivery medicine sales. Fuji Yakuhin Co., Ltd. has established base offices for sales of home delivery medicines in major cities throughout Japan from Hokkaido to Okinawa and now more than 3.5 million households are using this service. The company established a medical pharmaceutical division in 1995 and has expanded its sales business in the Kanto region mainly in Saitama Prefecture by using various strategies including the starting of a drugstore called “SEIMS.”

We visited the Toyama 2nd Plant which now utilizes the ULVAC Freeze-drying equipment for an interview and tour of the factory’s facilities.



Factory Specializing in Production of Medical Injection Fluids
Ideal Production Environment Utilizing an Ozone Microbiological Control System

Fuji Yakuhin Co., Ltd. was founded in 1930 and was established in April 1954 as Takayanagi Pharmaceutical Ltd. in Omiya City (current Saitama City), Saitama Prefecture, which was one of the places the company had visited for sales. The company subsequently opened a business office in Maebashi City, Gunma Prefecture, in October 1963. In February 1986, the company constructed a pharmaceutical manufacturing factory and started its production in Fuchu-machi in Toyama City, Toyama Prefecture. The factory is located in nearly the center of the Toyama plain commanding a view of the Tateyama Mountain Range. At present, the main business of the company consists of the following five components: sales of medicines for home delivery; drugstores; dispensing pharmacies; production of pharmaceuticals; and research and development of medical pharmaceuticals. In March of FY 2013, the company declared approximately 289.4 billion yen in total sales for the group and 11.7 billion yen as ordinary profits.

The Toyama Plant produces pharmaceuticals for medical and general use. The pharmaceuticals take various forms, such as tablets, capsules, granules, eye droppers, and ointments. The Toyama 2nd Plant operates a medical pharmaceutical manufacturing factory that produces injection fluids and medical pharmaceuticals and conducts contract studies of these medicines.

We visited the Toyama 2nd Plant. The factory started operation in 1992 specializing in production of medical injection fluids. It occupies an area of 29,000 m^2, and approximately 150 employees work there. In 2004, the factory introduced an ozone microbiological control system, the world's first system developed for microbiological control, into its clean room. With the aid of this system, the factory produces sterile products such as pharmaceuticals in ampoules and vials and freeze-dried formulation and carries out their formulation design and stability tests under contract.

The factory is capable of producing approximately eight million ampoules on its ampoule production line and approximately 14 million units per year on its freeze-dried formulation line.

An ozone microbiological control system is a sterilization system using ozone (O_3) which is a safe gas. An ozone microbiological control system consists of an ozone generating unit and an ozone decomposing unit installed in the air conditioning system of the production room. This sterilization system operates automatically to conduct the processes of fumigation, decomposition, and normal air conditioning in that order and thereby control the production environment essential for preparation of sterile fluids.

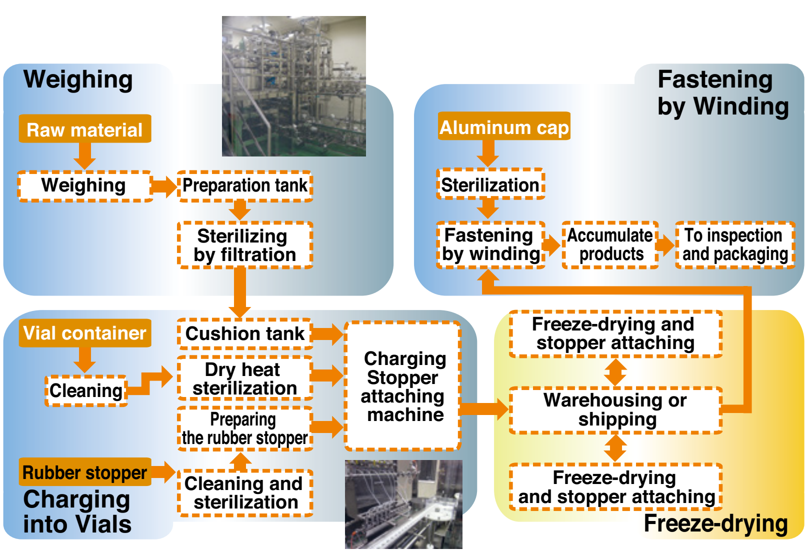

Injection fluid production facility


Weighing facility

Air conditioning facilities of the factory are under integrated control in the central monitoring room so the work environment can be thoroughly controlled by constantly monitoring the air cleanliness in the clean room. In addition, the production capacity of the facility for producing water for injection has been improved, and this water produced at the facility is also used to clean the containers and facilities that come in direct contact with medical solutions.

Pursuit of Quality and Pproduction Efficiency in Freeze-dried Formulation

Fuji Yakuhin Co., Ltd. has commenced use of the ULVAC's DFB series Freeze-drying. The production process for freeze-dried formulation proceeds under a production control system in the following order: raw materials are weighed by a predetermined method; a medical solution is prepared by a predetermined method; the prepared solution is put through sterilization by filtration and transferred into a tank. The following steps are then implemented. Namely, a vial container is cleaned with water for injection with the aid of ultrasonic waves; a rubber stopper is prepared by a sterilized rubber stopper prepping system, the medical solution is charged into the vial container with the aid of the mass flowmeter of a "mass flow measurement system." Charged vials are then transferred with a conveyer and automatically arranged in lines on shelves in a freeze-drying warehouse where they are put through a freeze-drying process. After this process, the vials are automatically taken out of the warehouse and put through fastening by winding



■Flowchart of process for producing freeze-dried formulation


ULVAC's Freeze-drying equipment
Upper photograph: Partial view of sterile room for automatic warehousing and shipping section
Lower photograph: Partial view of machine room section

on a conveyer. Finally, the vials are inspected and those vials that have passed the inspection are packaged as products.

Most of these processes are conducted at Grade-A level which is the highest air cleanliness level. Grade-A level areas are in aseptic manipulation areas and classified as high priority areas. The air cleanliness of all areas including aseptic areas is classified into Grade A through Grade D. According to the definition of air cleanliness at Grade A, the number of 0.5-µm or larger drifting particulates contained in 1 cubic meter of air must not exceed 3,520 either during or outside of the job operation.

This air cleanliness is equivalent to Class 5 of the ISO and Class 100 of the U.S. standards; this means that Grade A is equivalent to the level of bioclean rooms in hospitals.

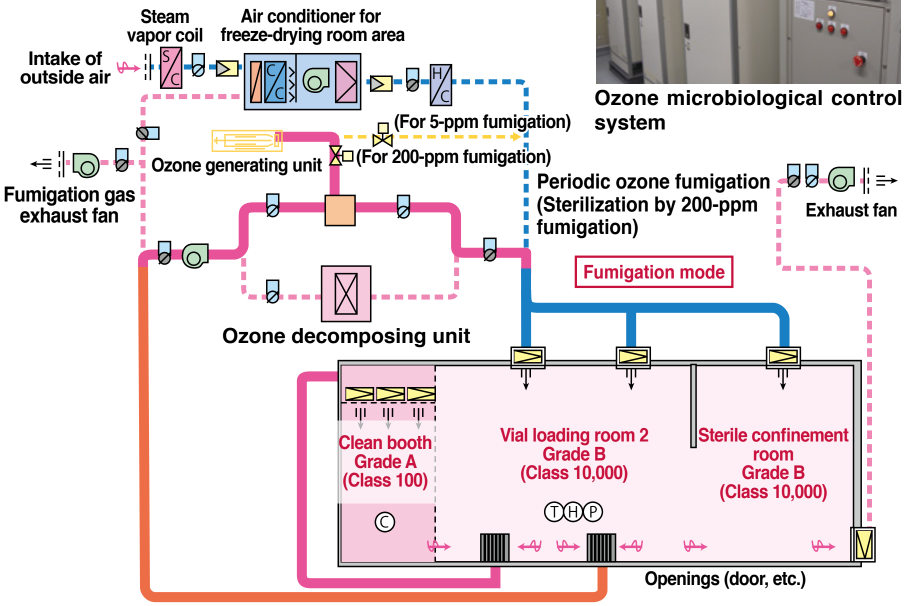
Quality Control Compliance with GMP

An even stricter control system will be established to support PIC/S.

Fuji Yakuhin Ltd. produces pharmaceuticals in clean zones whose environments are controlled as needed to comply with GMP, which is the world's strictest standard in this field. GMP is an abbreviation for Good Manufacturing Practice and is international standard for production of pharmaceuticals and quality control in production. The WHO (World Health Organization) passed the resolution for establishing the standards in 1968 and recommended that its member countries adopt these standards. In Japan, the Minister of Health, Labour and Welfare specifies standards in compliance with the Pharmaceutical Affairs Act.

Progress is being made towards consensus through agreements on inspection and establishing cooperative schemes for inspection in order to implement a worldwide uniform operation of PIC/S (a system for quality control of pharmaceuticals) and GMP standards. So starting usage of facilities and systems that support this trend will enhance management and consequently allow smooth progress in contract production for Japan's domestic and overseas customers. PIC/S is a collective name for the pharmaceutical inspection convention (PIC) and pharmaceutical inspection co-operation scheme (PICS) which are two cooperative organizations for GMP among governments and inspection organizations. PIC/S was established in Europe in 1970 and consists of organizations in approximately 40 countries at present. The member organizations are mainly in EU member countries and also include the U.S. FDA. This situation suggests that PIC/S is well on its way to becoming a global standard. Against this backdrop, Japan has also applied for membership in PIC/S and its application is currently undergoing an examination process (December 2013).

Ozone microbiological control system



■Structural outline of ozone air-conditioning system

Q&A exchange with the factory manager

We also make strong efforts in handing down techniques to our junior staff members for the future.

Mr. Sanae Tatara
General Manager of Toyama 2nd Plant, Fuji Yakuhin Co.Ltd.

—What advantages does Fuji Yakuhin offer?

Tatara: I think that we have the following three advantages. First, we have technical strength in sterile fluid preparation. Second, we are capable of contract production that satisfies the needs of our customers in detail. Large pharmaceutical manufacturers cannot currently provide this same type of service. Finally, we can provide a wide range of services from clinical testing to production and have successfully achieved standardized systems from production through sales when handling our products.

—By what are the main features of the Toyama 2nd Plant?

Tatara: We have the Toyama Factory and Toyama 2nd Plant. The Toyama 2nd Plant specializes in production of injection fluids. Many of the staff members working at the Toyama 2nd Plant are young with an average age of 33. There are strictly defined behavioral standards and all members are serious about performing their tasks in accordance with pre-established procedures. After work, however, they are all spirited and happy. The most striking feature of the Toyama 2nd Plant is the fact that its production is controlled by an ozone microbiological control system.

—Are there any future issues?

Tatara: We need to advance into overseas markets in order to expand. We have a large share of the domestic market in the sales of medicines for household delivery. We have also opened drugstores in Shanghai and are planning to expand the drugstore business elsewhere. We highly expect that positively supporting PIC/S will allow us to smoothly handle contract production for overseas export products. To make this happen, we have to increase our investment in plants and equipment. We must also put our energy increasingly into educating the younger generation. As part of this education, we will hand down techniques from veteran workers to younger staff members.

—Do you have any opinions on the ULVAC's Freeze-drying equipment?

Tatara: We have been using your Freeze-drying experimentally. We also make use of the loading system which you developed first and ahead of other companies. Your technical capabilities and quick support services are always helpful to us. Pharmaceutical production tends to depend significantly on the technical capabilities of facility manufacturers. So we hope that you will become even more highly aware of the fact that pharmaceutical manufacturers use production facilities in aseptic conditions such as in Grades A and B.

—I am looking forward to our continued business relationship. Thank you very much for your time today.

As key areas of ULVAC operations, North America and the emerging Latin America territories comprise a diverse set of markets that align with ULVAC's broad spectrum of vacuum-based technologies. These markets include next-generation memory and logic devices, TFB, PV applications, biomedical applications, MEMS devices, LED, EC glass, automotive, refrigeration/air conditioning, and many others. Within each of these markets there is a manufacturing sequence that ranges from R&D, to pilot production, to HVM (High Volume Manufacturing) in most cases. UTECH's mission is to evaluate the needs of these markets, and introduce the customers to the advantages of ULVAC products, both imported and domestically manufactured.

Wayne Anderson
President & CEO ULVAC Technologies, Inc.

VISITING ULVAC

ULVAC Technologies, Inc. (UTECH)

Head Office: Methuen, Massachusetts USA

Expanding Market Acceptance of ULVAC Products and Technologies to Meet R&D, Pilot Production and High Volume Manufacturing Needs

Production / Customer Support Network (North America)

UTECH employee/ X-mas Cruise at Boston harbor

An Introduction to ULVAC Technologies

When you think about it, if you consider the number of ULVAC manufacturing divisions, multiplied by the products of each, we are left with a wide matrix of product offerings and the challenge becomes, how do we support such a spectrum? The answer is that we are fortunate to have a workforce with many, long-term employees that possess a wide-range of product knowledge. At one point in time, UTECH employed 130 people. After the unfortunate events of 9/11/01, we were faced with a significant business downturn and as a result, reduced the size of our workforce by > 50%. However, today as a 55 employee company, we find ourselves leaner but more versatile and efficient than ever. Much like the 2013 World Series Champion Boston Red Sox, our success is built on a diverse, dedicated workforce willing to "play" multiple positions within the company as needs arise. I am proud to say that our teamwork has been and will continue to be vital to our success!

In our interview with the President Wayne Anderson, this issue of "Visiting ULVAC" will provide you with insight into the UTECH history, markets served, business philosophy and a brief look into the future.

A Brief History Lesson

ULVAC Technologies, Inc. (UTECH) was established on March 31, 1992 in Andover, Massachusetts in response to ULVAC, Japan's desire to globalize and create a Western Operations. However, ULVAC's roots in the United States pre-date this event in (2) locations: 1) At ULVAC North America Corporation based in Kennebunk, Maine which served as a distribution center for ULVAC products and a low volume/custom equipment manufacturer and 2) as part of a joint venture with BTU Engineering, Inc. in Billerica, Massachusetts; whereby diffusion furnace products/technologies (BTU) were exchanged with selective tungsten deposition systems (ULVAC ERA-1000). These (2) entities were dissolved upon the establishment of UTECH.

Prior to the establishment of UTECH in the 1980's, ULVAC acquired today's ENVIRO-based ashing technology from Emergent Technologies based in Connecticut. This company was owned by our old friend Dick Bersin. After the acquisition, process and product development continued in Japan for several years under the direction of Dick. These efforts ultimately lead to the introduction of the UNA-model ashing system, which was installed primarily, in Japan. This product was eventually transferred to UTECH and became the basis for our local manufacturing operation. Local manufacturing of the UNA transitioned from the initial "knock-down kit" approach, to 100% domestic sourced parts; whereby the product name was changed to "Phoenix". The product name has since been changed to "ENVIRO", to leverage its environmentally friendly solvent-free processing capability.

Market acceptance of our new product began to take hold in the mid-1990's, which created the need for UTECH to move to a facility that was more conducive to semiconductor equipment manufacturing. As a result, in 1997, UTECH engaged a construction firm to design and build a new 42,000 ft^2 semiconductor-grade facility that is our home today in Methuen, Massachusetts. Our facility offers a Class-10/100 demonstration laboratory to support ashing and etching technologies along with Class-1000/10,000 clean manufacturing space.

Over the years, our certified business operations at UTECH have grown to be quite widespread and offer a challenging work environment for our (55) member team, including a:

1) Center for sales and service for Import Products including systems and components into the North American and Latin American markets.
2) Center for the ENVIRO ashing product line including R&D, manufacturing, sales and service.
3) Center for ULVAC's etch technology penetration into the North American market.

Process Lab or Manufacturing

UTECH as an Antenna for Technology

The United States has always been one of the world's centers for leading edge research and development of new technologies and innovative products. Boston, Massachusetts is well known for its Universities, Colleges, and Medical Centers. UTECH's Headquarters was strategically located within close proximity to access these institutions. One of UTECH's missions is to be an antenna for discovering new technologies and innovative applications that are being developed here in Massachusetts as well as across the United States and Canada.

Some recent areas of successful business development include non-volatile memory technologies, electro-chromatic glass, and solid state thin film battery applications. The key to successfully developing these businesses include: (1) keeping close communications with the responsible ULVAC Equipment Division in Japan; (2) focusing on applications that play into ULVAC's strengths and technical advantages; and (3) investigating applications and technologies that are in line with the technology focus of ULVAC. By focusing on the right applications and armed with ULVAC's Global Engineering and Manufacturing strength, UTECH has been able to successfully develop businesses that will extend into the future.

Many of UTECH's customers are Universities, R&D centers, and venture companies because the United States continues to develop new technologies, applications, and products. As an antenna for these areas of business, UTECH has successfully landed customers that eventually will grow from R&D to full scale manufacturing. UTECH first attracts and then cultivates these types of customers. With ULVAC's engineering ability to transfer processes from R&D systems to manufacturing systems, the customer knows that they can depend on ULVAC to take them from R&D to volume manufacturing and to "scale" with the customer's requirements. Should the customer decide to build manufacturing facilities in regions outside of the United States, ULVAC's global network will support those customers even if they expand into places such as China, Taiwan, Southeast Asia or even India.

Strategies to Strengthen UTECH and Stimulate Growth

President Anderson explained that UTECH has adopted (3) fundamental policies to strengthen and grow our business. Let's explore each policy one-by-one:

1) **Sales and Marketing Policy:** We must continue to find new customers while continuing to provide excellent support to our existing customers. This will be achieved through the broadening and strengthening of our sales and marketing organization utilizing a combination of direct and representative resources. In addition, we will continue to expand our marketing efforts including A) the introduction of a new, more informative, easily navigated web-site B) increased trade show exhibitions and C) expansion of product advertisement efforts. Each marketing activity will be monitored for success level in an effort to ensure continuous improvement. Our hope is that by effectively implementing our sales and marketing strategies, we will strengthen ourselves through diversifying sources of revenues (i.e. industries where UTECH is active), profits and customer base to avoid the "all eggs in one basket" effect which can prove dangerous when markets pull-back.

2) **UTECH Operations Policy:** We must continue to take the necessary steps to strengthen our bottom line condition. The most significant step includes the expansion of our domestic manufacturing portfolio beyond our ENVIRO ashing family of products to now include the NE-550EXa Etcher, the NLD-570 Etcher, the CS-S Compact Sputter System, Automatic Leak Test Systems and others that are a good "fit" within our markets. By manufacturing more products locally, we expect to be able to offer more competitive pricing while yielding substantially increased gross margins over comparable import products. To maximize this effect, it is important for us to maintain strong supplier relationships with those offering the highest quality and most favorable pricing.
In addition, we have recently upgraded our Customer Service organization to improve responsiveness and to introduce a more aggressive approach to the pursuit of service contracts, spare parts business and customer training programs. The resulting business has mutual benefits to both our customer in the form of better tool performance/productivity and to UTECH in the form of strengthened financial results.

3) **Technology Focus Policy:** We must continue to serve as an "antenna" for ULVAC for technology trends as the US continues to be a center of R&D as well as a breeding ground for technology venture companies. Many of our customers are developing products for markets that are still in a very early (infancy) stage that may proliferate to world-wide, high volume manufacturing needs, as market demands increase. We see growth in areas related to energy and environment including LED/OLED, power device, solar, fuel cell, and solid state batteries. In the semiconductor market, emerging memory and logic technologies should serve as an area of growth and new business potential. And similarly, we expect new markets to emerge within the automobile industry. In summary, the involvement and success of ULVAC that can be demonstrated at the R&D stage puts us in a favorable position for new business when higher volume manufacturing needs arise.

A Look Forward

We continue to see the trend of slow but steady economic recovery in the United States. This trend has resulted in a gradual "return to buying" for many Americans. Positive economic indicators such as sales of new homes, automobiles, electronic devices, home appliances, etc. are all on the increase. Fortunately, vacuum based technologies are quite prevalent in the supply chain of these markets through the fabrication of memory and logic devices, MEMS devices, power devices, TFB's, automobile components and others. The economic recovery coupled with the trend of returning manufacturing to the US will likely yield increases in business opportunities for ULVAC products, technologies and services. We expect that our continued aggressive, focused business development and marketing campaigns will allow us to capitalize on these new opportunities and continue to fuel the growth of UTECH in the future.

Shared Vision

I Expect UTECH Serve Function as an Antenna for Advanced Technologies

Hisaharu Obinata
President and CEO
ULVAC, Inc.

In 1975, I participated in the establishment of the ULVAC North America Corporation (UNAC) as its first representative stationed in the United States at only 25 years of age. I am still proud of my participation in founding UNAC.

Fortunately, immediately after it was established, we received a large order from IBM for the world's first computer-controlled vapor deposition system. We also received orders for the world's most advanced devices one after another, such as a roll coater for film formation as a device ordered by the Bank of Canada to prevent use of counterfeit bills and an inline spattering system for magnetic disk production from Komag Inc.(As of 2007)

We had hard times during certain periods such as the Buy American movement triggered by trade friction as well as simultaneous terrorist attacks on September 11, 2001. However, we overcame those hard times and are now continuing to provide advanced systems such as cutting edge semiconductor production systems and TFB production systems.

The United States is a place that is constantly creating advanced technologies and at the same time is the world's largest market. I expect UTECH serve function as an antenna for advanced technologies and play role as the significant in the ULVAC group.

At the 11th Excellent Contribution to Industry-Academia-Government Collaboration Award Ceremony, the National Institute of Advanced Industrial Science and Technology (AIST) and Fuji Electric Co., Ltd. Jointly Received the Japan Business Federation Chairman's Award.

— ULVAC, Inc.

President Obinata, President Chubachi of AIST and Representative Director Shigekane of Fuji Electric (from the left)

At the ceremony held on the occasion of the 11th Escellent Contribution to Industry-Academia-Government Collaboration Award, ULVAC, Inc. jointly received the Japan Business Federation Chairman's Award along with AIST and Fuji Electric for its contribution to the establishment of "TPEC (Tsukuba Power-Electronics Constellations)" which is a joint research body based on vertical industry-academic collaboration.

Aimed at promoting industrial-academic-government collaborative activities, this award recognizes universities, public research institutions and businesses which have made significant achievements or pioneering efforts in such activities. This year 11 awards, including the Prime Minister Award, were granted for 14 activities. President Obinata participated in the awards ceremony and represented his company.

TPEC was founded by the AIST, universities and businesses in April 2012 as a center for SiC power semiconductor research. This is an advanced framework of the Initiative for Innovative Research in Industry "SiC Device Mass Production Prototype Research and System Application Demonstration" conducted by the AIST, Fuji Electric and ULVAC from 2010 to 2012.

Power electronics is a field where Japan is still highly competitive in the global market. TPEC is a joint research body which independently operates an open innovation center for power electronics with research and development funds mostly provided by related businesses that want to secure next-generation technology. In addition to research and development activities, TPEC aims to foster top grade researchers.

Starting its activities with the three award winners, including ULVAC, and other 13 leading Japanese companies, TPEC has now expanded to a total of 31 members. As a principal member, ULVAC plays a pivotal role in TPEC operations.

• Contact Information
ULVAC, Inc.
TEL: +81-467-89-2033
URL: http://www.ulvac.co.jp/eng/

The Thermoelectric Property Evaluation Device "ZEM-5" was Granted the Kanagawa Industrial Technical Development Incentive Award.

— ULVAC-RIKO, Inc.

ULVAC-RIKO is a manufacturer of thermoelectric property evaluation equipment. On October 2013, its thermoelectric property evaluation device "ZEM-5" which is an electric resistance measuring system won the incentive award for excellent technologies or products which is one category of the Kanagawa Industrial Technical Development Award that is bestowed on excellent industrial technologies or products developed by small and medium-sized companies that operate in the prefecture.

President Gonohe of ULVAC-RIKO (center) receiving a plaque from Kanagawa Governor Kuroiwa (right)

ULVAC-RIKO developed evaluation equipment such as the "ZEM-1" in 1995 and since then has made repeated model changeovers reflecting customer feedback. The name "ULVAC-ZEM" has constantly appeared in electronic editions of prestigious journals, such as "Science" and "Nature", and this evaluation equipment is now a de facto standard for thermoelectric measurement equipment.

In 2012, the company developed the "ZEM-5 series" intended for thin films and high temperature on the basis of the general-purpose "ZEM-3 series" to

New Products

* Please visit our website for further information.

ULVAC, Inc.

High-speed Spectroscopic Ellipsometers "UNECS Series" is Greatly Expanded its Products Line

ULVAC, inc. added new models of high-speed spectroscopic ellipsometers "UNECS Series", greatly expanded its products line.

UNECS series is a kind of spectroscopic ellipsometers to measure the refractive index and thickness of the thin film quickly and accurately.

It has a strong products line, such as the portable type, the automatic stage type, and the built-in type etc., so can meet various needs for many purposes.

Main Features

(1) High-speed Measurement:
The snapshot measurement method is realized and the high-speed measurement is 20ms per point

(2) Visible Spectral Range:
The spectral wavelength range can be selected. The standard type is 530nm to 750nm and the visible spectral type is 380nm to 760nm.

(3) Compact Sensor Unit:
The sensor unit is light-weighted and very compact. It consists of an optical element that does not have any rotating mechanism. In addition, there is no need for any periodic maintenance.

(4) Strong Product-line:
There is a strong products line with the portable type, the manual/automatic stage type, the built-in type and the large substrate type etc.

●Contact Information
ULVAC, Inc. Components Division
TEL: +81-467-89-2261
URL: http://www.ulvac.co.jp/eng/

ULVAC Technologies, Inc.

ULVAC Ships First - Made in USA – Plasma Etching System "NE-550EXa"

ULVAC Technologies, Inc. (UTECH) has

further meet market needs. The award was given as recognition for this functional improvement.

With this development, ULVAC-RIKO is expected to attract attention from researchers as well as developers of thermoelectric materials and to make extensive contributions to the development of a diverse range of thermoelectric materials.

• Contact Information
ULVAC-RIKO, Inc.
TEL: +81-45-931-2285
URL: http://www.ulvac-riko.co.jp/en/

Granted a Medical Device Manufacturing License under the Pharmaceutical Affairs Act

— ULVAC KIKO, Inc.

ULVAC KIKO was granted a medical device manufacturing license under the Pharmaceutical Affairs Act.

This supplier of small vacuum pumps for aspirators, sterilizers, oxygen concentrators and other medical devices is now licensed to manufacture medical devices as well as their components on its own and so is more prepared now than ever before to meet the various needs of medical device manufacturers.

In December 2011, Miyazaki Prefecture, where the company's head office is located, and neighboring Oita Prefecture were designated as a "special zone for the East Kyushu Medical Valley Framework" which is a governmental designated joint special zone, where special permission is given for deregulation and for other exceptional measures.

Taking advantage of this special zone, ULVAC KIKO aims to commercialize "automatic phlegm aspirators" developed jointly with Kyushu University of Health and Welfare and others as well as obtain "a manufacturing and marketing license for medical devices". With this license, the company will continuously contribute to the medical device industry.

• Contact Information
ULVAC KIKO, Inc.
TEL: +81-45-533-0205
URL: http://www.ulvac-kiko.com/

USA News

ULVAC Technologies, Inc. (UTECH) Awarded GINA and C2MI

GINA Award (March 2013):
UTECH was awarded the GINA Award for outstanding compliance with Export Control Regulations including ITAR (International Traffic in Arms Regulations), EAR (Export Administration Regulations) and C-TPAT (Customs-Trade partnership Against Terrorism).

C2MI (Center de Collaboration MiQro Innovation) (October 2013):
C2MI (Center de Collaboration MiQro Innovation) held a symposium in Bromont, Quebec, Canada, where UTECH was presented an award for the ENVIRO Ashing System, and its high ashing rate, and its contribution to the "green" technology of the Center.

UTECH will keep export under strict control, and continue to pursue technology for products and environment, to respond to the further expectations from customers.

• Contact Information
ULVAC Technologies, Inc.
TEL: +1-978-686-7550
URL: http://www.ulvac.com/

delivered the first domestically manufactured NE-550EXa plasma etching system to a Government Research Facility, in the Washington, D.C. area. The NE-550EXa is the most capable and flexible etching system for advanced research and critical manufacturing. The system operates at low pressure and with high plasma densities which ensures optimal etch rates, enhanced profile control, and improved surface flatness. The NE-550EXa is typically used in applications for III-V materials, insulating layers, organics, metals, ceramics, and MEMS devices.

ULVAC has been making etching systems in Japan since 1989. To better serve the R&D and smaller production facilities in North America, ULVAC Technologies began manufacturing etching systems at its Methuen, MA facility in 2012.

ULVAC Technologies, in Methuen, MA, is an ISO-9001 and ITAR* Certified manufacturing facility.

Domestic manufacturing enables lower pricing for U.S. customers, improves U.S. customer support capabilities, reduces the lead-time for new systems and spare parts, and provides better customer access to enhanced process support.

**ITAR: International Traffic in Arms Regulations*

●Contact Information
ULVAC Technologies, Inc.
TEL: +1-978-686-7550
URL: http://www.ulvac.com/

ULVAC, Inc.

Sales Debut of Optical Process Monitor "Optius", Enabling to Monitor the Situation of Various Process

ULVAC, Inc has begun selling new optical process monitor "Optius".

"Optius" has been developed for enabling to monitor the situation of various processes in real time by measuring an emission spectrum of the plasma. "Optius" can respond various plasma process like feedback control of introduced gas flow rate (PEM feature) in reactive sputtering, endpoint determination

Best/Good Standard Products of the Year Award—second anniversary of the internal awards system

— ULVAC Group

The ULVAC Group started an awards system for products which contribute to improving sales during the six months from July to December 2012. This year marks the second anniversary of this award or namely "the Good Standard Products of the Year Award". Among the various products receiving this award, the Group has selected the most superior product as the "Best Standard Product of the Year Award 2013". This year's winner of the "best" award is as follows:

[Best Standard Product of the Year Award 2013]

■Automatic helium leak tester, "QYH-3000"
(ULVAC Orient (Chengdu) Co., Ltd.)

The automatic helium leak tester "QYH-3000 series" is a high-precision leak tester for parts of air conditioners, cars, and electrical machinery with the following features:

(1) High-tech leak tester for parts using helium, a gas which can readily penetrate material in a vacuum, as a medium
(2) High-efficiency, high-precision device for industrial production
(3) Device for commercial use

[Good Standard Products of the Year Award 2013]

■Scan-type X-ray photoelectron spectroscopy analyzer "PHI5000 VersaProbe II™"
(ULVAC-PHI, Inc.)

The awards were presented at the production technology reporting meeting of the ULVAC Group companies in October 2013. At this meeting, representatives of each of these products made a commemorative speech and the divisions and group companies shared their best practices with each other. We aim to expand our business in this continuing activity.

●Contact Information
ULVAC, Inc.
TEL: +81-467-89-2033
URL: http://www.ulvac.co.jp/eng/

Automatic helium leak tester, "QYH-3000"

ULVAC Group

We conduct a variety of Social contribution activities at ULVAC Group.

In particular, social contribution activities such as volunteer activities have become important form the experience of the Great East Japan Earthquake. We have established policy and priority issues, and will lead to the promotion of social activities of ULVAC Group.

We would like to introduce our policy and priority issues.

■Priority Areas for Social Contribution Activities

New Products

* Please visit our website for further information.

(EPM feature), confirmation of the cleaning and initialization status, Monitoring of impurities during process.

Main Features

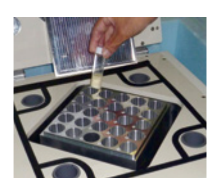
(1) Spectrometer is included. Measurement wavelength range is 200 to 1000nm. It is also possible to measure 10 arbitrary wavelengths.
(2) Addition of the expansion unit (ESC) options enable simultaneous measurement of up to 5ch.
(3) Feedback control of external equipment by measurement result of arbitrary wavelength.
(4) Software corresponding to multiple processes including the reactive sputtering and etching.
(5) Receiver unit can be selected from atmosphere type or vacuum type depending on the application.

●Contact Information
ULVAC, Inc. Components Division
TEL: +81-467-89-2261
URL: http://www.ulvac.co.jp/eng/

ULVAC-RIKO, Inc.

A microbe activity measurement system "Spica/Antares/Leonis"

ULVAC-RIKO, Inc. started the sales of "Spica" "Antares" "Leonis" whose systems can evaluate the activity of a microbe (vitality) and the dynamics (Growth rate) by measuring "Quantity of heat" which is emitted from microbial cells.



Those systems have features of capability of observing many samples simultaneously and non-destructively with a overwhelmingly little work, capturing the obtained data dynamically and obtaining them in the quantitative, in comparison with agar colony counting method and optical density measurement method with which a microbial activity is observed in the stationary condition.

We expect that those systems will be useful for the researchers who are studying the decomposition and fermentation of foods, antiseptic effect such as antimicrobial agent against liquid/solid, soil environment and pollution, garbage disposal and wastewater

Social Contribution Activities

●Contact Information
ULVAC,Inc.
TEL: +81-467-89-2033 URL: www.ulvac.co.jp/eng

ULVAC Group Social Contribution Activities Policy

Based on its corporate philosophy of contributing to the growth of industry and science with innovative, cutting-edge technologies, the ULVAC Group provides distinctive technological innovations globally and implements initiatives for solving various social problems by using ULVAC's technologies and human resources.

ULVAC Group Social Contribution Activities Record (FY2012)

Education support activities for the next generation	8
Regional community contribution activities	20
Environmental contribution activities	27
Total	55

"Tanbo (rice field) project" will pass it's 5th anniversary this year

treatment, and culture in which a microbe gets involved to execute research and development with not only the reduction of cost, time and labor but also obtaining many knowledge.

As a human being emits the heat while they are alive, all biological cells have an enthalpy changes along with a metabolism and creates the heat corresponding to it. Those systems enable to obtain the growth rate of a microbe and the change of activity under various conditions by measuring the time for emitting micro quantity of heat from a microbe, keeping the sample under the environment held with a constant temperature. As the dynamic behavior of the cell can be measured in the quantitative in a real time, those systems can be used in all fields not only foods but also the filed in which a microbe gets involved.

This system can basically correspond to any sample assembly where growth of cells and a microbe may occur. It is suitable for decomposition of food and understanding of antiseptic treatment, fermentation of food/ study of brewing, study of cosmetic and antiseptic treatment, precise evaluation of drug efficiency.

As the safety of food/eating habits is recently getting important, the predicting method of microbe pollution is very important and we expect this system can be applied in a wide range of fields as sure and reliable measures.

●Contact Information
ULVAC-RIKO, Inc.
TEL: +81-45-931-2285
URL: http://www.ulvac-riko.co.jp/en/

ULVAC Group

■ Japan
ULVAC, Inc.
ULVAC-RIKO, Inc.
ULVAC TECHNO, Ltd.
ULVAC KYUSHU CORPORATION
ULVAC TOHOKU, Inc.
ULVAC KIKO, Inc.
ULVAC EQUIPMENT SALES, Inc.
ULVAC CRYOGENICS INCORPORATED
ULVAC-PHI, Inc.
TIGOLD CORPORATION
ULVAC COATING CORPORATION
Nisshin Seigyo Co., LTD
Initium, inc.
ULVAC ENGINEERING, Inc.
ULVAC Human Relations, Ltd.
SHINKU CERAMICS CO., LTD.
FINE SURFACE TECHNOLOGY CO., LTD.
Reliance Electric Limited
SHOWA SHINKU CO., LTD.

■ China
ULVAC (China) Holding Co., Ltd.
ULVAC (NINGBO) Co., Ltd.
ULVAC (SUZHOU) CO. LTD.
ULVAC Orient (Chengdu) Co., Ltd.
ULVAC Automation Technology (Shanghai) Corporation
ULVAC Tianma Electric (Jingjiang) Co., Ltd.
ULVAC Vacuum Furnace (Shenyang) Co., Ltd.
ULVAC (Shanghai) Trading Co., Ltd.
ULVAC Materials (Suzhou) CO., LTD
ULVAC Opto-electronics Thin Film Technology (Shenzhen) Co., Ltd.
ULVAC CRYOGENICS (NINGBO) INCORPORATED
ULVAC NONFERROUS METALS (NINGBO) CO., LTD.
ULVAC Research Center SUZHOU Co., Ltd.
Luoyang Xinyou Magnesium Co., LTD
Hong Kong ULVAC Co., Ltd.

■ Taiwan
ULVAC TAIWAN INC.
ULTRA CLEAN PRECISION TECHNOLOGIES CORP.
ULCOAT TAIWAN, Inc.
ULVAC AUTOMATION TAIWAN Inc.
ULVAC SOFTWARE CREATIVE TECHNOLOGY, CO.,LTD.
ULVAC Materials Taiwan, Inc.

■ South Korea
ULVAC KOREA, Ltd.
Ulvac Korea Precision,Ltd.
Pure Surface Technology, Ltd.
ULVAC CRYOGENICS KOREA INCORPORATED
ULVAC Materials Korea, Ltd.
UF TECH, Ltd.

■ Southeast Asia
ULVAC SINGAPORE PTE LTD
ULVAC MALAYSIA SDN. BHD.
ULVAC (THAILAND) LTD.

■ North America
ULVAC Technologies, Inc.
Physical Electronics USA, Inc.

■ Europe
ULVAC GmbH

ULVAC WEB SITE:
http://www.ulvac.co.jp/eng/