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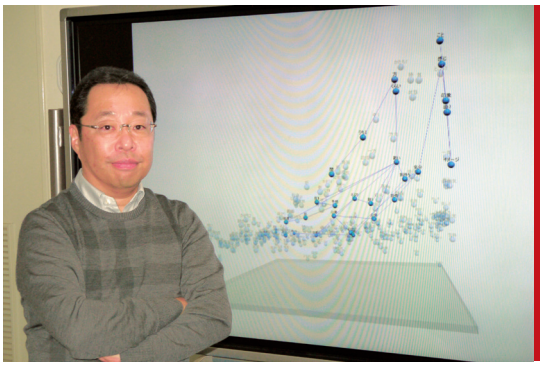
TOYOHASHI UNIVERSITY of TECHNOLOGY
e-Newsletter
News and views from one of Japan's most innovative and dynamic science and technology-based academic institutes



No.10, Mar 2013

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Improving the process of machine translation

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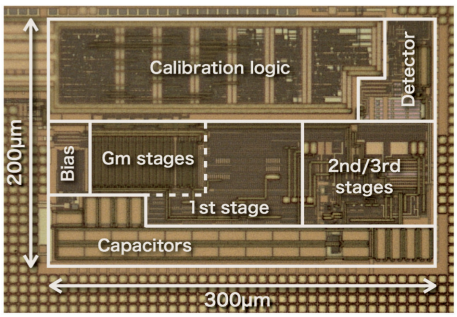
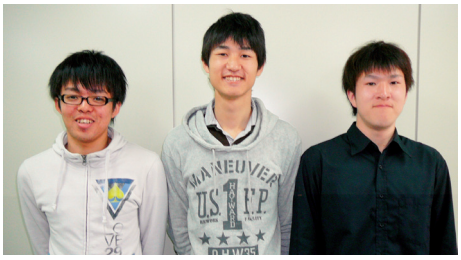
News



Research Highlights



Club Activities

Excursions

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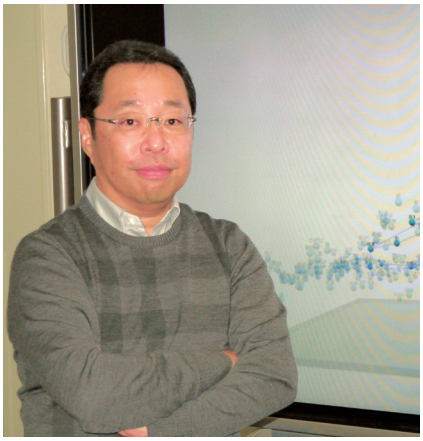


Hitoshi Isahara

And accuracy is particularly necessary for businesses selling their products overseas, which is why Isahara is working with companies in Japan's auto industry to help them provide better translated manuals for their products.

The current approach to MT most favored by researchers is to employ resource-based systems that use databases of near identical phrases in the source and target languages based on their frequency of occurrence. Isahara gives the example of the word "bank." If it is associated with "river" in a given text, then statistically it is more likely to mean the edge of a body of water, rather than an institution for lending money.

But English uses a subject-verb-object word order, while in Japanese, the verb comes at the end of the sentence. "This means we have to provide many more example sentences in Japanese, which greatly increases the size of the database, compared to when translating most European languages into English, as they also use a subject-verb-object order," say Isahara. "The computational power required for Japanese to come up with accurate matches is enormous."

Faced with such obstacles, Isahara is taking a three-step approach to improve the situation: simplifying the Japanese source text, extracting and listing salient expressions and their equivalents in a document and enhancing the post-editing process.

For example, he is devising a set of guidelines and rules for writers of Japanese manuals that will be used as the source for MT. These rules include writing shorter, simpler sentences; adding the subject when missing; and providing context when there is ambiguity.

As for post-editing, which can be costly and time-consuming, Isahara is conducting an experiment using 22 foreign students attending Toyohashi Tech to post edit machine translated versions of the university's English Web site into their own languages. The software used is Microsoft Translator.

The results of this experiment will be compared with those of post edited versions by professionals, and though Isahara doesn't expect the same degree of accuracy from the students, he notes that they have a better understanding of the context, and so this kind of collaboration could improve the post-editing process and reduce costs.

"Our approach, then, is not to focus on just one aspect of MT," says Isahara. "Rather we want to improve and support the entire machine translation process."

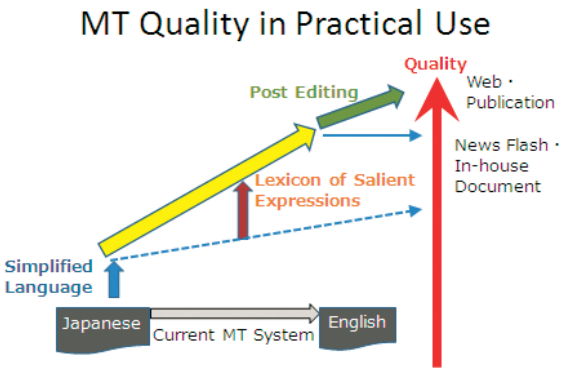


Fig.1: MT Quality in Practical Use

Opening Ceremony for TUT-EEPIS Joint Project of DEGREE, Development of EEPIS Graduate Engineering Education

On November 15th, the Toyohashi University of Technology (Toyohashi Tech) held the "Ceremony for TUT-EEPIS Joint Project of DEGREE, Development of EEPIS Graduate Engineering Education" with the Electronic Engineering Polytechnic Institute of Surabaya (EEPIS) in Nagoya City.

Group photograph of the participants

The EEPIS is a polytechnic institute established in Surabaya in 1988. In its establishment, the polytechnic received grants and technological cooperation from mostly from Japan International Cooperation Agency (JICA). In November 2010 when President Yoshiyuki Sakaki visited Indonesia, he was requested by Prof. Dr. Mohammad Nuh, the Minister of Education and Culture of The Republic of Indonesia, for support in elevating EEPIS's higher education. Following this request, the Toyohashi Tech established the EEPIS Education Advancement Support Cooperation Technical Committee under the Head Office for International Strategy and has been preparing for the cooperative support. By July 2011, a memorandum that verified the support that would be implemented was signed, and cooperative activities commenced that included preliminary instructions, for example, for EEPIS teachers to enroll in the doctoral course at Toyohashi Tech.

The ceremony was attended by Prof. Dr. Mohammad Nuh, Minister of Education and Culture, who was in Japan to attend the Japan-Indonesia Rectors' Conference that was also being held at Nagoya University on the same day, as well as Prof. Dr. Djoko Santoso (MSc. Director General of Higher Education, Ministry of Education and Culture of The Republic of Indonesia), Dr. Dadet Pramadihanto(Director, EEPIS), Dr. Rusminto Tjatur Widodo(Vice-principal, EEPIS), Dr. Akhmaloka (President, Bandung Institute of Technology), and others, as well as Dr. Yoshiyuki Sakaki(President, TUT), Dr. Kiyokatsu Jinno (Executive Trustee, Vice President), and Mr. Toshiaki Tsuji (Director-General) from Toyohashi University of Technology, and from the Institute of National Colleges of Technology (INCT), Dr. Hidefumi Kobatake (President,INCT), Dr. Masato Kitani (Executive Director,INCT), and Dr. Jun Kyokane (Director, INCT & President, Akashi NCT)


Prof. Dr. Mohammad Nuh, Minister of Education and Culture of the Republic of Indonesia and Prof. Dr. Yoshiyuki Sakaki, President of Toyohashi Tech.


Student speaking of his aspirations in front of Prof .Dr. Nuh and others

After an explanation of the background leading to this day and the details of the support by President Sakaki, Prof. Dr. Mohammad Nuh expressed his gratitude for the support given by Toyohashi Tech, and it was acknowledged that both schools would press forward with collaboration and cooperation in the future. Furthermore, each of the 4 students who enrolled in the university's doctoral course from this October spoke in front of Prof. Dr. Mohammad Nuh, the President of EEPIS, and teaching advisors, of their ambition and determination to devote themselves totally to their research at Toyohashi Tech for the next 3 years.

ICCEED's 11th Open Forum on University-Industry-Government Linkage and Engineering Education in Developing Countries

On November 22, International Cooperation Center for Engineering Education Development (ICCEED), Toyohashi Tech held the 11th Open Forum as its annual event entitled "University-Industry-Government Linkage and Engineering Education in Developing Countries" at the International Conference Hall in JICA Ichigaya Building. The forum was supported by the Ministry of Education, Culture, Sports, Science and Technology (MEXT), and Japan International Cooperation Agency (JICA). Over 60 people from universities, organizations for international cooperation, and private companies participated in the forum.

Prof. Naohiro Hozumi of Toyohashi Tech making a presentation at the forum.

The topic of the forum was motivated by active links among university, industry, and government (U-I-G links for short) in Japan, especially in engineering. U-I-G links have provided benefits for each of the universities, industries and governments. What are the challenges related to the introduction of systems for U-I-G links into developing countries? What do developing countries expect for U-I-G linkages?

In light of these subjects, general and practical issues on U-I-G links were presented in the forum by distinguished speakers. After opening remarks by Mr. Yoshihisa Nagayama (Director, International Affairs Division, MEXT), Ms. Nobuko Kayashima (Director General, Human Development Department, JICA) gave a keynote speech on an overview of U-I-G links in developing countries. Prof. Naohiro Hozumi (Toyohashi Tech) reviewed international cooperation activities organized by ICCEED. Prof. Tsuyoshi Usagawa (Kumamoto University) explained JICA technical cooperation projects led by him to boost research activities of graduate schools in Vietnam and Indonesia. Prof. Phan Dinh Tuan (Ho Chi Minh City University of Technology, Vietnam) emphasized the importance of research-based education to enhance U-I-G links. Prof. Rahula Anura Attalage (University of Moratuwa, Sri Lanka) delivered his talk on an organization and its major outputs for U-I-G links by the MEXT International Cooperation Initiative project. Matters raised in the talks were then extensively discussed among the audience and the speakers in the panel discussion session, and the discussion continued for a while after the forum.


Dr. Phan Dinh Tuan, Ho Chi Minh City University of Technology

Thai university student group visits Toyohashi Tech under the Kizuna Project: Youth-Exchange Project of Asia-Oceania and North America

On 3rd December 2012, 13 Thai university students and 5 accompany staff visited Toyohashi Tech as part of a program of exchanges with Japanese universities under the Kizuna Project: The Youth-Exchange Project of Asia-Oceania and North America.

This project includes exchanges with more than 10,000 youths (high school students, university students, and so on) from 41 countries and regions in Asia-Oceania and North America. The project was organized by the Japanese government with the aim of enhancing the understanding with other countries by sharing disaster and reconstruction experiences via high school, university, and regional exchanges, and volunteer activities, as well as contributing to the reconstruction of the disaster-stricken areas.

First, the students were given a welcome speech and an explanation of the general outline of Toyohashi Tech by Professor Naohiro Hozumi, Director of the International Cooperation Center for Engineering Education Development. Then, they received a lecture regarding the importance of building damage and seismic strengthening in a large earthquake by Dr. Seishi Yamada, Director of the Research Center for Collaborative Area Risk. In addition, the Thai university student group gave a presentation about their observation of Kesennuma. Following this, the Japanese students also joined the discussions, and divided into groups, to discuss "disaster prevention, energy, and food safety," and gave presentations afterwards. The discussions unfolded into lively debates regarding Japan's disaster prevention system and energy issues.

Group photograph of the participants. Professor Naohiro Hozumi, Director of the International Cooperation Center for Engineering Education Development is third from them left on the front row.

After lunch, the students toured the structural testing installations at the Seismic Engineering Laboratory (Associate Professor Tomoya Matsui's Laboratory at the Department of Architecture and Civil Engineering) for a description of materials used for preventing or lessening building damage during an earthquake. They were also given a description of earthquake-resistant construction used at Toyohashi Tech buildings.

The visitors from Thailand also learnt about calligraphy with the International Exchange Club as part of the exchange with Japanese students. They experienced some aspects of Japanese culture as they watched Japanese students write 'kanji characters' and afterwards tried to write some characters themselves.

This visit was a great opportunity for both Thai and Toyohashi Tech students to deepen mutual understanding.

The structural testing installations at the Seismic Engineering Laboratory

Small instrumentation amplifier for high density arrayed sensor devices

Small-area, low-power, low-noise instrumentation amplifiers (IA) are critical components of arrayed sensor devices used for high-spatial-resolution biomedical and environment monitoring system.

However, in order to realize small offset voltages of IA, conventional IAs utilize analog filters—composed of large passive components, resistors and capacitors— resulting in excessively large silicon chips.

Now, Ippei Akita and colleague at Toyohashi University of Technology have developed a novel architecture for fabricating smaller sized integrated circuit chips. The technique is based on a digital calibration scheme for minimizing the offset voltage of the IA circuit, instead of an analog scheme used in conventional circuits.

The offset exists mainly at the first-stage circuit of IA. In this design, the researchers introduced a reconfigurable first-stage circuit. The best configuration for minimizing the offset was easily determined by calibration logic which was implemented in a small area compared to analog circuits.

The proposed IA was implemented in a standard 0.18 micrometer CMOS and resulted with an offset voltage of < 3.5 μV while drawing a current of 194 μA. The active area of the IA is 7.8 times smaller than conventional state-of-the-art chips while maintaining low noise and low power.

Ippei Akita

The researchers plan to use the proposed IA for the fabrication of an arrayed IA for high-spatial-resolution and real-time sensing systems.

Reference:
Ippei Akita and Makoto Ishida, "A 0.06mm2 14nV/√Hz chopper instrumentation amplifier with automatic differential-pair matching", IEEE Int. Solid-State Circuits Conf. Dig. Tech. Papers (ISSCC), pp.178-179, Feb. 2013

•Affiliation: Department of Electrical & Electronic Engineering, Toyohashi University of Technology

•Website: http://www.int.ee.tut.ac.jp/icg/

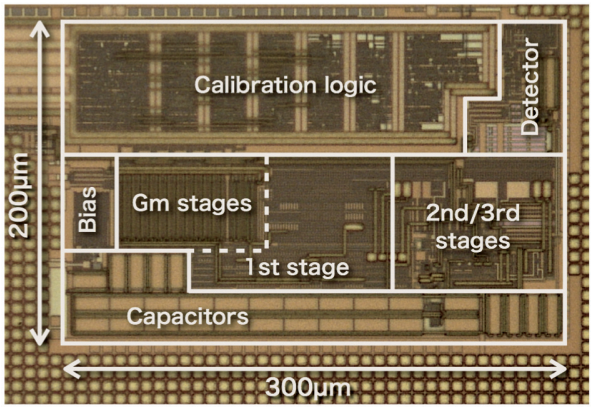


Fig.1: Microphotograph of the instrumentation amplifier chip.

Inorganic-Organic Hybrid Photovoltaic Devices as sustainable energy generation

Hybrid inorganic-organic photovoltaic devices are attractive as next generation high efficiency thin film solar cells, but the photovoltaic performance is still low level compared with inorganic solar cells of Si, Cu(InGa)Se2 , and organic solar cells of C60.

With this background it is necessary to investigate the fundamental aspects of these materials including the molecular configuration, energy state, and band alignment to improve photovoltaic performance.

Here, Masanobu Izaki and colleagues fabricated hybrid p-Cu2O/C60 photovoltaic device on <111>-oriented Au -coated Si substrates by electro-deposition of Cu2O layer followed by vacuum evaporation of the C60 layers as an acceptor layer.

The C60 layers exhibited face centered cubic molecular configuration on the <111>-oriented Cu2O layer, and the preferred orientation changed from random to <111> plane depending on the preparation methods.

The electrical characteristics of hybrid photovoltaic devices varied depending on the C60 molecular configuration, and a rectification characteristic with an ideality factor of approximately 1 was achieved for hybrid <111>-Cu2O/<111>-fcc- C60/ bath cuproine photovoltaic devices.

This research underscores the importance not only of the configuration of both organic and inorganic semiconductors but also of the introduction of

Masanobu Izaki

nanostructures in the light-absorbing layer and optimization of the band alignment at the heterointerface in hybrid photovoltaic devices.

Reference:
Masanobu Izaki, Takamasa Saito, Tatsuya Ohata, Kazufumi Murata, Binti Mohamad Fariza, Junji Sasano, Tsutomu Shinagawa, Seiji Watase, "Hybrid Cu2O diode with orientation-controlled C60 polycrystal.", American Chemical Society, Applied Materials & Interface, 4, 3558-3566 (2012)

•Digital Object Identifier (DOI): 10.1021/am3006093

•Affiliation: Department of Mechanical Engineering, Toyohashi University of Technology

•Website: Thin Film Laboratory [http://tf.me.tut.ac.jp]

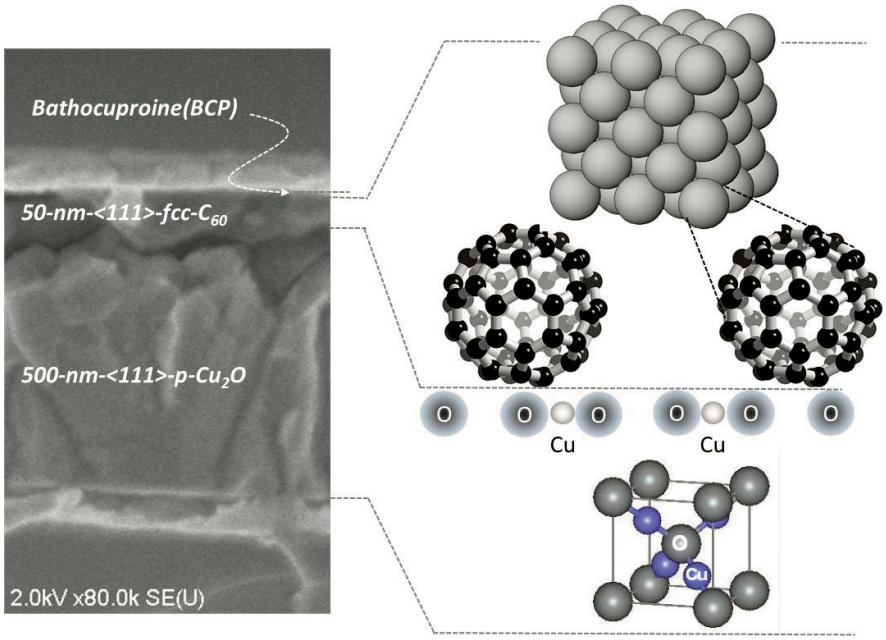


Fig.1:FE-SEM image of the cross-section of the hybrid p-Cu_2O/C_{60}/BCP photovoltaic device and schematic illustrations of Cu_2O and C_{60} structures.

High-performance electrolyte membrane for advanced fuel cells operating at medium temperature without humidification

Fuel cells are so called clean energy devices that convert chemical energy from a fuel into electricity via electrochemical reactions. Of the various types of cells, polymer electrolyte fuel cells (PEFCs) have attracted attention as power sources for household co-generation units, portable devices, and electric vehicles.

Atsunori Matsuda

The operating conditions of the PEFCs are generally restricted to be lower than 100℃ and under high humidity due to the properties of widely used perfluorosulfonate membranes such as Nafion®. Solid state proton conductive membranes with high conductivity in the medium temperature range (100–200℃) even under low humidity are required as electrolytes for PEFCs. Now, the operation of PEFCs in the medium temperature range improves the utilization of total electric power generated in the cells and reduced the poisoning of Pt catalysts with CO in the fuel gases. In addition, the operation of PEFCs under low humidity permits the reduction of the weight and volume of humidifiers.

Atsunori Matsuda and colleagues at Toyohashi University of Technology developed a high-performance electrolyte membrane for advanced fuel cells operating at medium temperature and without humidification. The new electrolyte membranes are composed of highly proton conductive inorganic compounds and phosphoric acid-doped polybenzimidazole (PBI). The inorganic compound was prepared from inorganic heteropoly acid containing tungsten and silicon with alkali hydrogen sulfate by high-power mechanical milling. The research team successfully reduced the additive amount of phosphoric acid to improve the chemical durability.

The maximum output of a fuel cell using this electrolyte film reached the world's highest level of 350mW/cm2 at 160℃ without humidification. The long term stable power generation under these conditions was confirmed to 800 h. These results demonstrate that the newly developed inorganic-organic composite electrolyte membranes have high potential for the practical application for advanced fuel cell systems.

Reference:
[1] Song Yul Oh, Toshihiro Yoshida, Go Kawamura, Hiroyuki Muto, Mototsugu Sakai, and Atsunori Matsuda, "Inorganic-Organic Composite Electrolytes Consisting of Polybenzimidazole and Cs-Substituted Heteropoly Acids and Their Application for Medium Temperature Fuel Cells," Journal of Materials Chemistry, 20, 6359 (2010)

•Affiliation: Department of Electrical and Electronic Information of Engineering, Toyohashi University of Technology

•Website:http://ion.ee.tut.ac.jp/

Fig.1:Photograph of the newly developed inorganic-organic composite electrolyte membrane for the advanced fuel cell systems operating at medium temperature without humidification.

Carbon nanocoils fracture like an automobile spring

Carbon nanocoils (CNCs) composed of helical shaped carbon nanofibers have potential applications including mechanical springs, nano-solenoids, and field emitters.

However, in spite of the important applications of CNCs as mechanical spring for nano-eletcromechanical system (NEMS) there is a scarcity of data on CNC fracturing under tensile loads.

Here, Taiichiro Yonemura and colleagues at Toyohashi University of Technology describe the CNC fracturing properties of eight CNCs using focused ion beam (FIB) modification.

CNC tensile tests were conducted as follows: The CNCs were installed into an FIB system with a tungsten (W) probe with a 500 nm tip diameter and the W probe moved until it adhered to CNC using Pt ion beam whereas the Si ion beam cut the CNC bottom; then the CNC-adhered W probe approaches a Si substrate surface, until the CNC was almost perpendicularly to the Si substrate. Tensile tests for 8 CNCs were carried out by gradually changing the distance between the Si substrate and the W probe.

The elongation behavior of CNCs in the FIB instrument was monitored. Experiments showed the CNC coil pitch to return to its original length after fracturing, thus confirming CNC to be a spring. The average stretch ratio of the 8 CNCs on the verge of fracture was 150%.

The ratio of the maximum to average

Yoshiyuki Suda

stress on the fractured surface was estimated to be in the range 1.3 to 1.7 indicating stress concentrations on the coil wire inner edge, and scanning microscopy confirmed a hollow region on the inner edge of all fractured surfaces.

The starting point of the CNC fracturing observed in the inner edge matched that of industrial steel coil springs used in automobiles.

Reference:

Taiichiro Yonemura, Yoshiyuki Suda, Hideto Tanoue, Hirofumi Takikawa, Hitoshi Ue, Kazuki Shimizu and Yoshito Umeda, "Torsion Fracture of Carbon Nanocoils", Journal of Applied Physics, 112, 084311 (2012)

•Digital Object Identifier (DOI): 10.1063/1.4758921

•Affiliation: Department of Electrical and Electronic information Engineering, Toyohashi University of Technology

•Website: http://www.tut.ac.jp/english/introduction/department02.html

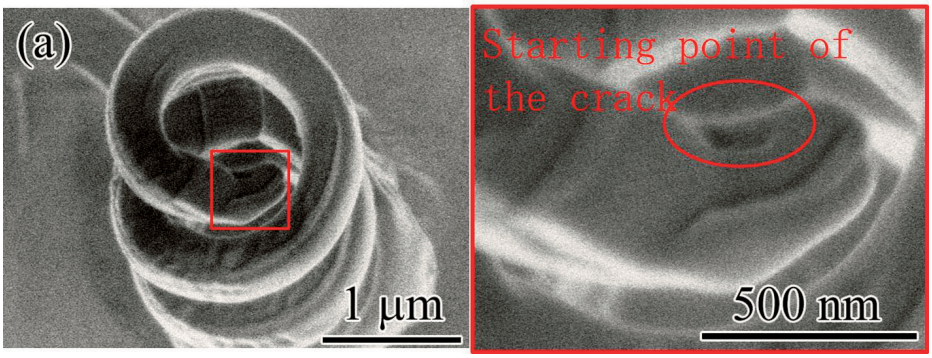


Fig.1:Carbon nanocoils

Toward a new earth-friendly resource circulation system for poly(L-lactic acid)

Poly(L-lactic acid) (PLLA) is attractive for use as a biodegradable plastic material that can be employed for general use instead of petroleum-derived plastics. Since it is estimated that a large amount of waste is discharged along with the diffusion of PLLA chains, an effective way of using PLLA waste is necessary to establish a new earth-friendly resource circulation system.

A promising method involves the use of PLLA instead of general-purpose exogenous soluble substrate, such as methanol, as the reducing power for denitrification in nitrogen removal from wastewater.

However, much less effort has been directed towards the use of PLLA in denitrification processes because of the low biodegradability. In fact, the nitrate removal property of denitrification processes with PLLA has been shown to be much lower than that of other biodegradable plastics such as poly(3-hydroxybutyrate-co-hydroxyvalerate) and poly(ε -caprolactone).

Here, Takeshi Yamada and collegues at Department of Environmental and Life Sciences, Toyohashi University of Technology report on the use of PLLA waste as external electron donors in denitrification processed by changing its weight-average molecular weight and microbial communities that are responsible for the PLLA-added denitrification processes.

The researchers prepared PLLA pellets of *Mw* of 45,100, 12,000 and 9,900 operated denitrifying reactors for 2 months, which contained activated sludge as the seed and 1 % (as reactor volume) of PLLA as the substrate. The population dynamics of denitrifying bacteria

Takeshi Yamada

in the reactors were investigated by cultuire-dependent and culture-independent polyphastic approaches with nonmetric multidimensional polyphasic approaches.

PLLA having an *Mw* of approximately 10,000 is suitable for the denitrification process, offering good nitrate removal efficiency. The culture-independent approaches with statistical analyses and culture-dependent approaches suggest that bacteria belonging to family *Comamonadaceae* predominated and played a role in denitrification in the wastewater treatment processes. Also, nitrate removal property of the denitricationreactor with PLLA is attained through the bioavailability of hydrolysates released abiotically from the PLLA.

This study showed a suitable adjustment condition for the use of PLLA wastes as an external electron donor in denitrification processes. In addition, a large potentiality of PLLA was shown as an earth-friendly biodegradable plastic.

Reference:
Masaaki Takahashi, Takeshi Yamada, Motohiro Tanno, Hideto Tsuji and Akira Hiraishi, "Nitrate removal efficiency and bacterial community dynamics in denitrification processes using poly (L-lactic acid) as the solid substrate", Journal, volume, pages and year: *Microbes Environ*, 26, 212-219 (2011)

•Affiliation: Department of Environmental and Life Sciences, Toyohashi University of Technology

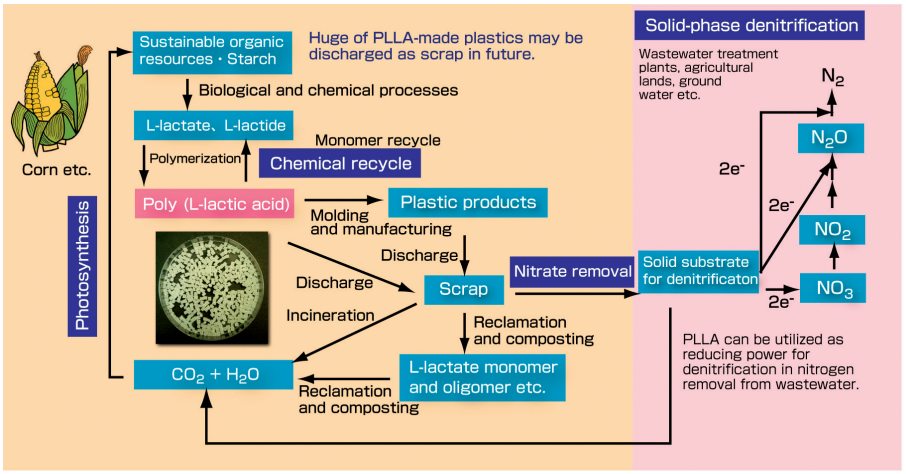
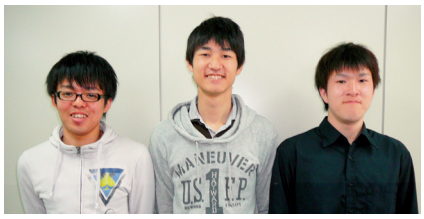


Fig.1: A new earth-friendly resource circulation system for poly (L-lactic acid) (PLLA),suggested by authors.

Toyohashi Tech A Cappella Circle: A circle of singers

While many of us prefer to confine our singing to the shower, members of a Cappella Circle JUST, like to come together to sing, which is why the initials stand for Join Us Sing Together.



Members of the Toyohashi Tech a Cappella Circle at the interview

The club was started about 20 years ago by a few like-minded singers and today it boasts around 35 members, including three female singers. They meet twice a week and practice for more than three hours a time, splitting up into a number of groups, depending on the songs being practiced.

The members, naturally, are all aficionados of karaoke and claim to be accomplished solo singers in the shower. "We all joined because we like singing," says Takuya Ishikawa, the club's leader and a fourth-year student of Mechanical Engineering. "We sing all kinds of songs—whatever the members choose. Popular right now are J-Pop, ballads and classics such as Stand By Me, Top of the World and Desperado."

The group gives several live performances each year. A memorable event was held in July 2012: an inter-university occasion, when they were joined by two other university singing circles from the Tokai region and attracted an audience of one hundred. Other performances include the Toyohashi Tech university festival, an event at Christmas and a demonstration performance in spring, the beginning of the academic year, given to attract new members. Sometimes they are also invited by local businesses to sing live, while their biggest recent event took place in a park in Nagoya, with the crowds being too numerous to count.

Team "Roku" held a concert at a department store

"Everyone is welcome to join," says Hiroki Matoba, in his fourth year studying Computer Science and Engineering. "Even singers with limited voices can sing well softly, while others may be good at percussion vocalizing such as mimicking drum sounds, for example."

Another member, Sho Kawaharada, a second-year student of Mechanical Engineering, joined the club after "watching a program on TV about choral groups. Being a member of such a group looked really enjoyable, so when I learned Toyohashi Tech had this singing circle, I was happy to join."

Though many of the members are also interested in musical instruments, singing unaccompanied is a special challenge worth taking on. "Singing in front of a large audience without the help of musical backing is a great experience," says Matoba. "It really helps build your confidence."

Team "Yukari" held a concert at a department store

Forklift trucks at Toyota Takahama Plant in Takahama city

Tresna Dewi, Department of Mechanical Engineering

Toyota Takahama Plant in Takahama city is the core of Toyota Material Handling Group (TMHG) and had a 18.8% global market of the forklift in 2010.

It was not my first time to visit a Toyota factory but it was my first visit to Toyota Takahama Plant. This visit to the Toyota L&F factory producing forklift trucks, was an opportunity to see firsthand how forklifts are diligently assembled, step by step, to high quality forklifts.

Before going to the factory, we were briefed about the production system and policy at the Takahama Plant. It was very impressive to learn how they adopted the basic concept of "jidoka" (automation) and "just in time". In the "Jidoka" concept, if there are any problems, the machine involved automatically stops and operators stop work and correct the problem immediately so that no defective products are made; and the "just in time" concepts means producing and supplying only what is needed, when it is needed, and in the amount needed by the next step in the production process. This approach reduces waste that may arise by overproduction. The Takahama Plant also puts great effort on ensuring that only high quality products are manufactured.

Toyohashi Tech students at the Toyota Takahama Plant in Takahama city.

Although this factory employs such a high working attitude, in Takahama Plant, workers put safety first and we saw how they are trained intensively about their safety so that they understand safe and less safe situations.

We also had the opportunity to see the "dojo" or learning facility for assembly, welding, and painting for the workers before they work in the actual factory to enhance operator skills. Also, the Takahama Plant has many robots which work in harmony with workers.

This excursion study gave me and my colleagues a better understanding of an industrial manufacturing system not only at Toyota but in Japan.

I would like to thank Toyohashi University of Technology, Greater Nagoya Initiative Center and the Management of Takahama Plant for this excursion study. I am looking forward to another excursion trip for insights into the Japanese industrial system.

Introduction to the Toyohashi Tech e-Newsletter

The *Toyohashi Tech e-Newsletter* is a quarterly publication with updates of news, research, and other activities at the Toyohashi University of Technology (Toyohashi Tech). This printed issue is an abridged version of the original *Toyohashi Tech e-Newsletter No. 10* that was published on-line in March 2013.

Original *Toyohashi Tech e-Newsletter No. 10*: http://www.tut.ac.jp/english/newsletter/

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- Small instrumentation amplifier for high density arrayed sensor devices
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