



Toyohashi University of Technology

Interdisciplinary Research
Symbiosis of Science and Technology

Science



An advertorial feature produced by the
Science/AAAS Custom Publishing Office

Interdisciplinary Research Symbiosis of Science and Technology



Founded in 1976, Toyohashi University of Technology—one of Japan's most dynamic science- and engineering-based universities—is a vibrant, modern national institute with research activities reflecting the modern era of advanced electronics, engineering, and life sciences. President of Toyohashi University of Technology, Yoshiyuki Sakaki, a molecular biologist by training and leader of Japan's team in the Human Genome Project, shares his thoughts about the lessons learned from the genome project and his interdisciplinary approach to research.



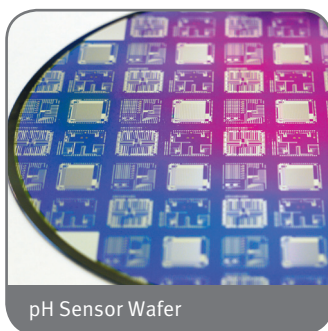
Yoshiyuki Sakaki, president of Toyohashi University of Technology, is energetic and engaging. In addition to his innovative style of university management, Sakaki is renowned for his internationally recognized contributions to molecular biology and his leadership as the head of the Japanese group in the Human Genome Project—launched in 1989, with a mandate to sequence the DNA, and map all of the genes, in the human genome. The project published the first draft of the results in 2000, ahead of schedule, followed by more detailed and complete data in 2003.

“It would not be an overstatement to say that the Human Genome Project was unprecedented and highly ambitious, as it was the largest international research project in the life sciences,” says Sakaki. “It is often called the Apollo project in life sciences. Our goal was to unravel the mysteries of the human genome; it was extremely challenging.”

Sakaki stresses the importance of the complementary nature of basic science and technology for the success of the project. “As a molecular biologist I am fully aware of the role that fundamental science and scientists played in the discovery of the molecular structure of DNA,” says Sakaki. “But the success of the genome project was made possible by the inspired engineers, who developed the technology that enabled the automated sequencing of the genome. Participation in the genome project taught me the importance of an appropriate mix of science and technology in modern research; the development of automated sequencing technology was a critical turning point in the genome project.”

The genome project consisted of an international consortium with teams based in United States, United Kingdom, Japan, Germany, France, and China. “Although this was a truly international project, I think it would be fair to say that we did wave our own national flags on certain occasions,” says Sakaki with a smile. “As leader of Japan's team, my first challenge was recruiting key players with the appropriate skills to establish a large-scale data production pipeline. Luckily, I found an excellent applied chemist, a thoughtful molecular biologist, and an expert in bioinformatics. These three people played critical roles during the early days when we needed to extract and analyze large volumes of information. I am also indebted to the leaders of the USA and UK teams for their support and assistance during the project.”

Sakaki is applying his knowledge and experience as head of Japan's team in the genome project to the administration of Toyohashi University of Technology, known colloquially as Toyohashi Tech. “One of my major



pH Sensor Wafer

goals as president is to build on the efforts of my predecessors, and continue to create infrastructure conducive to pursuing cutting-edge research,” says Sakaki. “I want our faculty to have the ambition and resources to compete with the world's top researchers.” In the realm of education, Sakaki has launched programs to nurture engineers with creative and challenging minds capable of contributing to society on a global scale.

Toyohashi Tech is internationally acknowledged for research in microelectronics. “Our electronics-based research is the foundation for the Electronics-Inspired Interdisciplinary Research Institute (EIIRIS), which we launched in October 2010,” says Sakaki. Makoto Ishida,

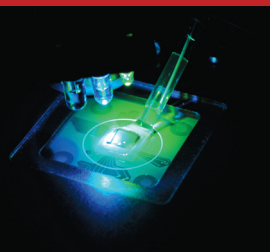
the director of EIIRIS, is also the inventor of the Toyohashi Probe Chip—an array of wire-like electrodes inserted into living cells to directly extract neuron signals. The probe array comprises vertically aligned silicon nanowires that have been integrated into silicon circuits through a vapor-liquid-solid growth process. The probe was recently used for measuring neural signals in the retina of a fish, which is the first major step for demonstrating the effectiveness of this technology (see figures on the opposite page).

More recently, Toyohashi Tech Professor Kazuaki Sawada developed another innovative piece of technology, a new pH image sensor. This charge-couple device-based imaging system enables real-time, two-dimensional visualization of changes in the distribution of protons and ions during, for example, stimulation of cells by external stimuli such as light and chemicals.

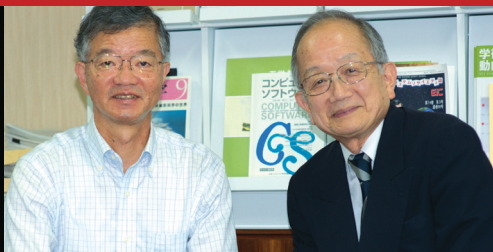
EIIRIS is building on the university's history of research excellence in electronics, medical diagnostics, agriculture, and information communication technology. “Our goal is to open new frontiers in interdisciplinary research,” explains Sakaki. “EIIRIS is the flagship of interdisciplinary research at Toyohashi Tech.”

Director Ishida explains that the unique environment at EIIRIS was carefully planned to “encourage open discussion on topics ranging from molecular diagnostics to environmental monitoring, in order to tackle some of the daunting challenges of the 21st Century.”

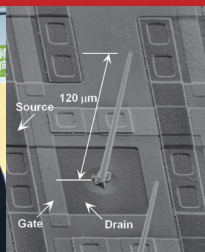
Sakaki emphasizes the importance of the selecting highly ambitious research staff for EIIRIS. “In addition to funding for the building and infrastructure for EIIRIS, the Japanese Ministry of Education, Culture, Sports, Science and Technology, or MEXT, also supported the creation of a new tenured professorial chair at the institute,” says Sakaki. “And, we were delighted to have this chair filled by the multitasking Adarsh Sandhu, a bilingual physicist from the United Kingdom who researches



pH Imaging System



Professors Makoto Ishida (left) & Yasuyoshi Inagaki



Toyohashi Probe



Adarsh Sandhu



EIIRIS Building

About Toyohashi University of Technology

The university is located at the heart of Toyohashi City, Aichi Prefecture, in central Japan. The Pacific Ocean is only a short bicycle ride away from the Tempaku campus with the panoramic views of the surrounding mountains adding to its spectacular location. Toyohashi city has a mild climate, low cost of living, and is within easy reach of Nagoya, Tokyo, and Osaka.

The university has ~250 faculty and ~2200 full-time students (of whom 10% are from overseas, with the majority coming from Asia). Toyohashi Tech emphasizes practical training—including a two-month internship organized by the university with companies both in Japan and abroad.

Toyohashi Tech has eight research centers focusing on areas including intelligent sensing, robotics, agrotechnology, and optical information storage.



Omotegama Beach on the Pacific Ocean



Mountains near Cape Irago

nanobiomagnetism and has 25 years of industrial and academic experience in Japan. He will play a central role as chief scientist in shaping the future of EIIRIS.”

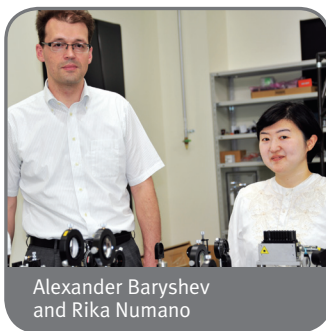
The institute also houses an international team of 10 up-and-coming researchers—including Alexander Baryshev, one of three researchers from overseas, and Rika Numano, one of two female researchers—with diverse backgrounds including neuroscience, biotechnology, electromagnetism, robotics, and photonics. “In addition to pursuing their own research projects, these tenure-track researchers also mentor graduate student assistants assigned to the institute,” explains Vice President Yasuyoshi Inagaki, head of the Tenure Track Program. “These researchers must also lecture Toyohashi Tech students as part of the requirements for tenured positions.”

Excellence in research and education, international visibility, and industrial collaboration are some of the important goals for President Sakaki as he moves ahead with his plans for Toyohashi Tech—a university that not only has a student population similar in size to that of the California Institute of Technology (Caltech) in the United States, but one that also considers Caltech to be an excellent model for its future development.

“In addition to EIIRIS being our center for research, I would also like to make it the base for an international graduate school, where the majority of classes would be taught in English,” explains Sakaki. “We would hire full-time English-speaking research staff who would use their scientific and language skills to play a leading role in educating graduate students. I envisage offering scholarships for highly motivated doctoral students from both Japan and overseas.” This idea is still in the planning stages but EIIRIS expects to recruit its first doctoral students in spring 2012.

Since its establishment, the university has organized a unique set of courses and seminars for its students as well as two month industrial internships for final year undergraduates. “I genuinely believe that giving students the opportunity to meet and talk with top industrial leaders is another important aspect of education,” says Sakaki. “With this in mind, I launched the so-called Prestige Lectures two years ago, where we invite industrialists and opinion leaders to give a talk to our students and members of the local community, followed by a discussion with some of our doctoral students. Past speakers have included senior executives from Toyota Motor Company, Mitsubishi Chemical Corporation, Nippon Steel Corporation, and Sharp Corporation as well as leading scientists including Nobel Laureate Hideki Shirakawa.

To fulfil President Sakaki’s goal of increased international visibility, the

Alexander Baryshev
and Rika Numano

university launched the Toyohashi Tech e-Newsletter (www.tut.ac.jp/english/newsletter/index.html), an on-line source of information about research, education, and events at Toyohashi Tech. The e-Newsletter is published quarterly and includes engaging content, images, and videos highlighting the university’s research and innovation.

Furthermore, the university will be hosting the inaugural Asia-Pacific Interdisciplinary Research Conference 2011 (AP-IRC 2011) on 17 and 18 November 2011 at the Tempaku campus. The AP-IRC 2011 will cover three main areas: electronics, life sciences, and green technology. The deadline for abstracts is 31 August 2011 and peer-

reviewed papers will be published in the Institute of Physics’ Journal of Physics: Conference Series. “We hope that the interdisciplinary platform of the AP-IRC will act as a catalyst for graduate school students, academics, industrialists, and opinion leaders to find solutions to some of the major issues facing the world,” says Sakaki.

President Yoshiyuki Sakaki has a clear vision for the future of Toyohashi Tech. “I have had the opportunity of working with talented scientists, engineers, and administrators,” says Sakaki. “I have learned the importance of an interdisciplinary approach toward successful research. Also, I believe that the key to breakthroughs at universities, government institutes, and industrial labs does not depend on the size or even the location of such research centers. Rather, it depends on whether the research environment has the critical mix of expertise in fundamental science and fundamental technology. The symbiosis of science and technology is critical for the creation of new intelligence.”

Further Information

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Online Resources

Asia-Pacific Interdisciplinary Research Conference 2011
www.apirc.jp/index.html

Electronics-Inspired Interdisciplinary Research Institute (EIIRIS)
www.eiiris.tut.ac.jp/index.html

Toyohashi University of Technology website
www.tut.ac.jp/english/

The Asia-Pacific Interdisciplinary Research Conference 2011

AP-IRC 2011

アジア太平洋異分野融合研究国際会議

<http://www.apirc.jp>

- + Green Science and Technology
- + Innovative Mechano-Magneto-Electronic Systems
- + Life Sciences

Invited Speakers (tentative)

- H. J. Gross (Würzburg University, Germany)
- J.-S. Jang (LED-IT Fusion Technology Research Center, Korea)
- Q. Pankhurst (The Royal Institution of Great Britain, UK)
- M. Sagawa (Intermetallics Co., Ltd., Japan)
- V. M. Shalaev (Purdue University, USA)
- Y. Tozawa (Ehime University, Japan)

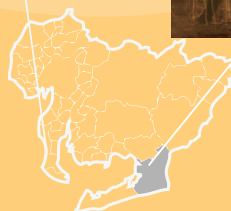


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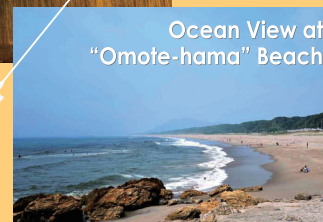
Tempaku
Campus



AICHI



Traditional Firework
"Tezutsu Hanabi"



Ocean View at
"Omote-hama" Beach

NOV 17-18th 2011

Toyohashi University of Technology,
Toyohashi, Aichi, Japan

Deadline for abstract submission: Aug 31st 2011

Organized by the following groups at Toyohashi University of Technology

Electronics-Inspired Interdisciplinary Research Institute (EIIRIS)

Tenure Track Program to Foster Young Researchers

in Cutting-Edge Interdisciplinary Research

Global COE Program "Frontiers of Intelligent Sensing"

Head Office for "Tailor-Made and Baton-Zone" Graduate Course

