TOYOHASHI
UNIVERSITY OF TECHNOLOGY
Master Technology, Create Technology

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. 14, February 2014

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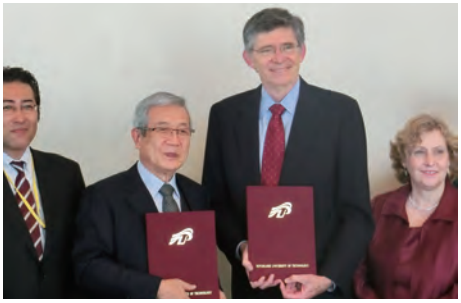
Though much underappreciated by the layman, ceramic materials play a vital role in modern manufacturing and are found in thousands of products including the brakes on cars, knives, and electronic devices



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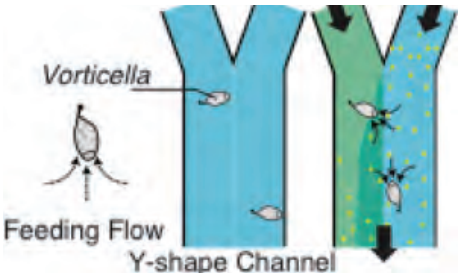


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# Focus on ceramics

Though much underappreciated by the layman, ceramic materials play a vital role in modern manufacturing and are found in thousands of products including the brakes on cars, knives, and electronic devices. In her role as a materials scientist, Hiromi Nakano in Toyohashi Tech's Cooperative Research Facility Center, is investigating ways to study and control the interaction of ceramic material properties using transmission electron microscopy (TEM), which enables analysis of the structure of materials on the atomic scale.

"Because the important characteristics of ceramic materials arise from the material's structure at the smallest level, we can use the transmission electron microscope to conduct analysis at the level of their atoms," says Nakano. "In this way we are able learn how to control the mechanisms of these properties, which can lead to the design of new materials."

Hiromi Nakano in Toyohashi Tech's Cooperative Research Facility Center

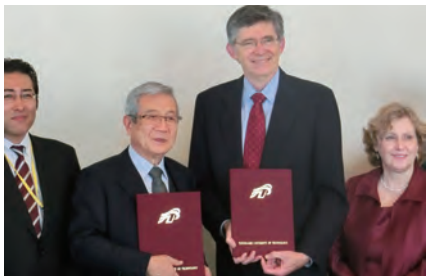
In one set of experiments, she conducted in-situ TEM observations of ceramic oxides placed at high temperatures. By observing the changes taking place in materials under heating, she observed the conditions that led to the disappearance of pores. In addition, she was able to observe the process of grain growth, thereby gain insights into the thermal behavior of the nanoparticles.

"By making long-term observations of the crystallization process and grain growth of these oxides, we were able to clarify the mechanism behind the formation of naonocrystaline particles," says Nakano. "This has resulted in our proposing a new theory of grain growth in ceramics."

# Agreement on Student Exchange Program with Queens College, City University of New York

Following on from the exchange agreement between Toyohashi University of Technology (Toyohashi Tech) and Queens College of the University of New York (signed on 29 July 2013), Toyohashi Tech President Yoshiyuki Sakaki visited Queens College, City University of New York on 16 December 2013 to sign an agreement with James Muyskens, the president of Queens College, covering the Implementation of a Student Exchange Program. This is part of the Trilateral Collaboration and Educational Reform in the National University Reform Enhancement Promotion Project, marking the first step in overseas research initiatives to further the development of global human resources for education.

President Sakaki also gave a keynote lecture the next day on "Decoding the Human Genome: from a view of successful cooperation of science and technology."



President Sakaki and President James Muyskens

Keynote Lecture by President Sakaki

# Opening Ceremony Held for TUT-USM Penang

An opening ceremony was held on 4 December 2013 in Penang, Malaysia, for the launch of TUT-USM Penang, which is the overseas educational facilities of Toyohashi University of Technology (TUT or Toyohashi Tech)in collaboration with Universiti Sains Malaysia (USM). About 300 people including President Yoshiyuki Sakaki, government officers attended the ceremony. The tape-cutting by president and distinguished guests was followed by traditional Malaysian lion dances and other events to celebrate the event.

The IGNITE 2013 symposium was also held on the following day at the Penang Shangri-la Rasa Sayang Resort and Spa Hotel to commemorate the opening.

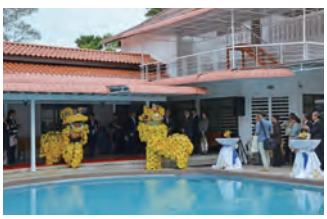
The establishment of the TUT-USM Penang overseas education base is part of National University Reform Enhancement Promotion Project, and will be used for sending Japanese students for language learning and internships at local companies, learning manufacturing in coordination with these companies and allowing them to reassess Japanese culture and diversely absorb other cultures.

Go to the following link for more details on the TUT-USM Penang.
http://penang.ignite.tut.ac.jp/

Commemorative tape-cutting

Participants at the IGNITE symposium


President Yoshiyuki Sakaki's speech



Lion Dance


Entrance Hall

Lecture Room

IGNITE 2013 Symposium

# Cilia of Vorticella for Active Microfluidic Mixing

Active elements are fundamental components of many microsystems. Traditional elements with nonliving, artificial actuators require an external power source for operation, with magnetic and electric fields necessary to drive the active elements and increase the size of the devices.

The active element size is an obstacle that hinders further miniaturization of microfluidic systems and which therefore prevents compact system fabrication. Sophisticated biological motors from living microorganisms are applicable in microsystems functionalization while reducing the overall size of devices.

Moeto Nagai and colleagues at Toyohashi University of Technology have shown directional fluid transport induced by coordinated ciliary motion in living Vorticella microorganisms for microfluidic applications.

Moeto Nagai

Fluid transport was applied to enhance the mixing of solutions containing microparticles in a microchannel that had been functionalized with Vorticella. Two solutions were injected and a stable laminar continuous flow was generated to measure the mixing performance. Changes in intensity profiles and mixing indexes were measured along the flow direction. A method to pattern Vorticella in micropockets was also developed to extend the possibilities for device design.

Particle transport by several cells of Vorticella enhanced the mixing of the solutions. Decreasing the flow speed enhanced the mixing performance. A three-layer device equipped with a pneumatic valve enables confinement of Vorticella with removal of the suction pressure. Most trapped cells adhered in the pockets for 6 h. The pocket geometry controlled the Vorticella posture.

Application of the coordinated ciliate motion is expected for portable bioanalytical systems capable of analyzing less-diffusive materials.

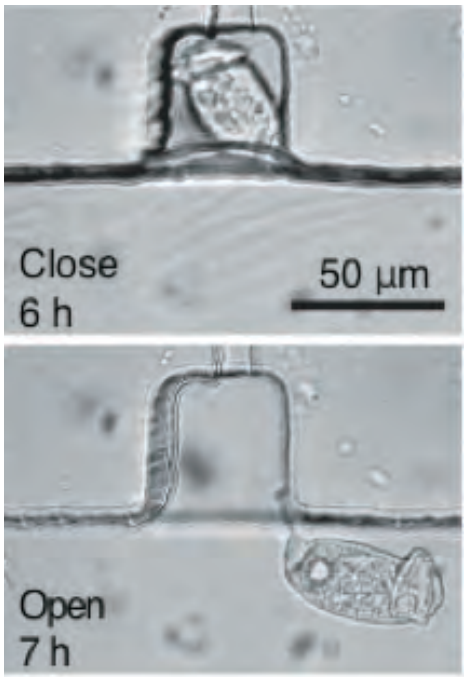



Fig.1: Micrograph of Vorticella in microchannel.

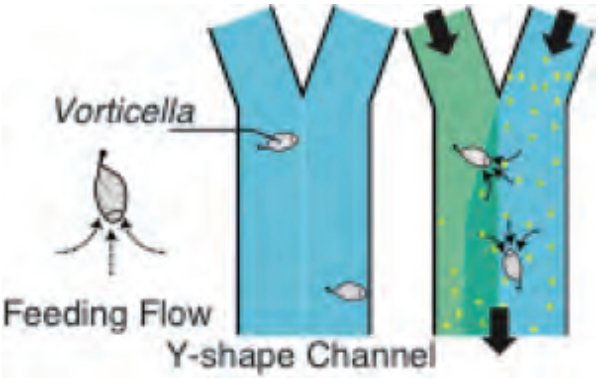



Fig.2: Schematic of micromixing by Vorticella.

Reference:

- Authors: Moeto Nagai, Yo Hayasaka, Kei Kato, Takahiro Kawashima, and Takayuki Shibata.
- Title of original paper: Mixing of solutions by coordinated ciliary motion in *Vorticella convallaria* and patterning method for microfluidic applications.
- Journal, volume, pages and year: *Sensors and Actuators B: Chemical* 188, 1255–1262 (2013).
- Digital Object Identifier (DOI): 10.1016/j.snb.2013.08.040
- Affiliation(s): Department of Mechanical Engineering, Toyohashi University of Technology.
- Website:http://mems.me.tut.ac.jp/

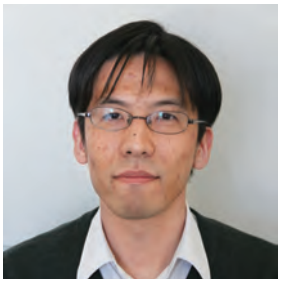
# Label-free biosensor based on a microelectromechanical system Fabry–Perot interferometer integrated with a photodetector

Label-free biosensors can be applied in many processes such as rapid diagnosis, tailor-made medication, and drug discovery. Label-free microelectromechanical system (MEMS)-based sensors detect target molecules by measuring the deflection of cantilevers caused by biomolecular adsorption.

However, it suffers from poor sensitivity because of the low conversion efficiency of linear transducing from the mechanical deflection to the readout signal.

Kazuhiro Takahashi and colleagues at Toyohashi University of Technology have developed a biosensor based on a MEMS Fabry–Perot interferometer integrated with a photodiode, which utilizes the nonlinear optical transmittance change in the Fabry–Perot interference to enhance the sensitivity. The theoretical minimum detectable surface stress of the proposed sensor was predicted to be -1 μN/m, which is two orders of magnitude greater than that of the conventional MEMS sensor.

The Fabry–Perot sensor was fabricated using a 4-inch p-type silicon wafer. The photodiode was integrated into the silicon substrate using ion implantation of phosphorus. Sacrificial polysilicon was isotropically etched to form a free-standing membrane. Amino-methyl-functionalized parylene was coated on the membrane for immobilization of the biomolecules via electrostatic coupling. After immobilizing anti-bovine serum albumin antibodies, the photocurrent change of 23.7 nA was measured, whereas no current shift was observed in the initial photocurrent as compared with that after washing with buffer solutions.



Kazuhiro Takahashi

The MEMS Fabry–Perot interferometric sensor allows the use of a universal biochemical sensing platform in a label-free manner.

Reference:

- Authors: Kazuhiro Takahashi, Hiroki Oyama, Nobuo Misawa, Koichi Okumura, Makoto Ishida, and Kazuaki Sawada.
- Title of original paper: Surface stress sensor using MEMS-based Fabry-Perot interferometer for label-free biosensing.
- Journal, volume, pages and year: *Sensors & Actuators* B 188, 393-399 (2013).
- Digital Object Identifier (DOI): 10.1016/j.snb.2013.06.106
- Affiliation(s): Department of Electrical and Electronic Information Engineering, Toyohashi University of Technology.
- Website: http://www.int.ee.tut.ac.jp/icg/

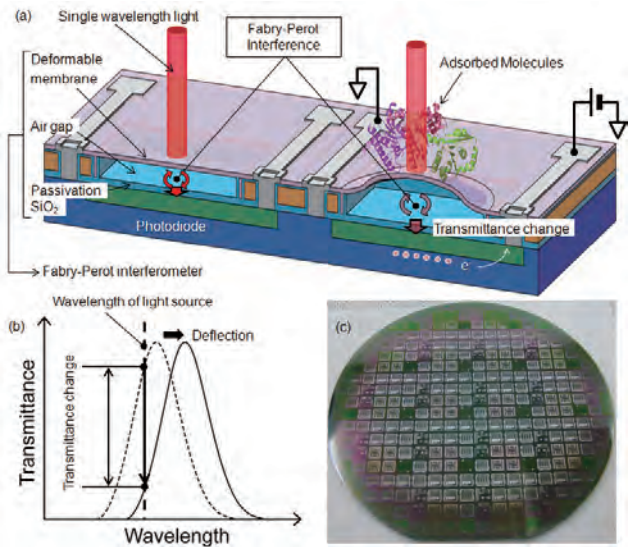



Fig.1: (a) Schematic image of the label-free biosensor based on a MEMS Fabry–Perot interferometer. (b) Schematic diagram of the transmission spectrum of the Fabry–Perot interferometer on the biosensor. (c) Photograph of the developed MEMS Fabry–Perot interferomtric biosensor.

# Silver nanoparticle on graphene oxide support: An efficient catalyst for organic transformations

Silver (Ag) has a high catalytic activity towards many organic and inorganic transformations such as NOx reduction and catalytic oxidation of CO to $CO_2$. In practical applications, catalysts like Ag are affixed to a substrate, usually a solid with a high surface area such as alumina or carbon.

To efficiently use Ag as a catalyst, its specific surface area must be maximized by reducing its particle size. Moreover, the development of simple and low-cost synthesis method is highly desired for practical applications.

Now, Tran Viet Thu and colleagues at Toyohashi University of Technology have shown that graphene oxide (GO) sheets can be used as an excellent support for the growth of Ag particles. GO was first prepared from commercial graphite by oxidation and exfoliation in water. Then the Ag-GO hybrids were prepared by a chemical reduction route using GO and silver nitrate as precursors, sodium borohydride as reducing agent, and trisodium citrate as stabilizer. Transmission electron microscopy imaging showed very small size (3.6±0.6 nm) Ag particles to be decorated on GO sheets, compared with Ag particles synthesized without GO (tens of nm in size). This decrease in particle size means more Ag atoms were present at the surface and a large increase in the specific surface area. As a result, the Ag-GO hybrids were more efficient for the catalytic conversion of 4-nitrophenol (toxic pollutant) into 4-aminophenol, an intermediate for the production of several drugs. In addition, the Ag-GO hybrids exhibited improved catalytic activity compared to Ag particles synthesized without GO.

Tran Viet Thu

The research suggests a low-cost route for the synthesis of catalytic Ag-GO hybrids and highlights the promising use of GO as a support for other functional nanostructures.

Reference:

- Authors: Tran Viet Thu, Pil Ju Ko, Nguyen Huu Huy Phuc, and Adarsh Sandhu.
- Title of original paper: Room-temperature synthesis and enhanced catalytic performance of silver-reduced graphene oxide nanohybrids.
- Journal, volume, pages and year: *Journal of Nanoparticle Research* 15 (10), 1-13 (2013).
- Digital Object Identifier (DOI): 10.1007/s11051-013-1975-9
- Affiliations: Electronics-Inspired Interdisciplinary Research Institute (EIIRIS) and Department of Electrical and Electronic Information Engineering, Toyohashi University of Technology
- Website:http://www.eiiris.tut.ac.jp/index.html

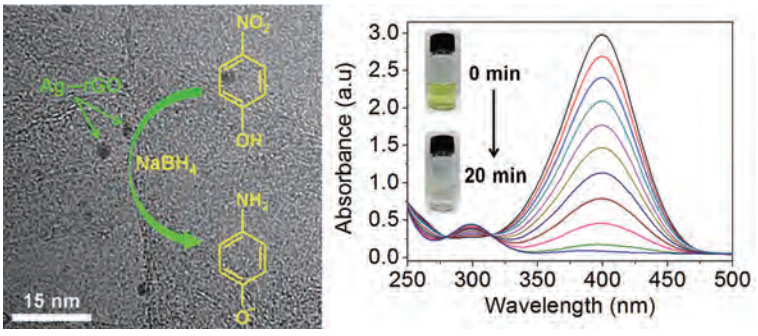



Fig.1: (Left) Transmission electron microscopy image of Ag-rGO nanohybrids. The inset shows the catalytic conversion of 4-nitrophenol to 4-aminophenol.
Fig.2: (Right) Absorption spectra of 4-nitrophenol decreases in intensity and its color fades (inset) due to catalytic conversion.

# Toyohashi Animation & Comics Society (TACS)



Akitoshi Kubo, manager of the Toyohashi Animation & Comics Society (TACS)

The Toyohashi Animation & Comics Society (TACS) has been active for over twenty years. There society currently has 56 members who are passionately interested in animation and comics and meet during lunchtime or after classes from Monday to Friday. The activities of the society include drawing and evaluating pictures as well as working in large groups to create animated films and games.

The club has a great atmosphere where you can find whatever suits your interest, and you are sure to find friends with similar interests. The Cel Creation Workshop is a regular event held during the annual university festival in autumn. Anyone, young or old, can participate in this event. Cels (celluliod) is an old technique used for creating animation, and involves painting on a plastic sheet. With the rise of digital animation, this technique is almost unused now, but the society continues to run this workshop each year so that people can experience the fun of animation.

If you want to increase your knowledge of comics and animation, TACS is the place to come!

Members of TACS.
Mr. Kubo is in the front row, third form the left

Please look at the blog describing the society's activities!
http://tacs-web.net/


Digital Candy by "Masuzaki" and "SELECT"

Golden haired idolin Japanese clothes by "kordy"

Cel Creation Workshop during the university festival

# Momiji Matsuri Shinshiro City



De Schepper Karel, Department of Mechanical Engineering

On 16th November 2013 I went with a group of ten students to visit Shinshiro, Aichi Prefecture, approximately 90 minutes from the Toyohashi Tech campus. Members of the international office of Shinshiro picked us up from Toyohashi Tech in the afternoon and guided us to a village located at the starting point of a hiking course to the peak of Mt. Houraiji. The mountainous city of Shinshiro is located north of Toyohashi. As during this excursion, the mountains make it quite difficult for the city to modernize or industrialize, yet the beautiful scenery has its own merits.

When I arrived at the village, I could smell such fresh air; it was very refreshing. We were surrounded by mountains covered by brown, red and yellow trees. While walking around in the village and listening to stories about Shinshiro, we enjoyed the experience seeing and being a part of Japanese nature, which included the famous Japanese maple trees, or momiji, in their most splendid autumn colors.

After our walk we visited the night museum, which was built to educate people about the type of fauna and flora of Shinshiro. One of the remarkable animals in Shinshiro is the Eurasian Scops Owl, or 'konohazuku', which can also be seen in the night museum. This owl lives in various countries in Asia and Europe. However, one of their breeding places in Asia is in the woods of Shinshiro. Some also believe that character 'Totoro' in the 1988 Japanese animated film 'Tonari no Totoro' directed by Hayao Miyazaki and produced by Studio Ghibli is based on the konohazuku because of the remarkable resemblance of the pointy ears. Also the mountainous scenery of Shinshiro seems quite similar to that featured in other productions of Studio Ghibli.

In the evening the mountain village was lit up by candles along the walking paths which produced a very pleasant and relaxing atmosphere. Everyone felt relaxed after the trip and we all fell asleep on the bus back to the campus. We did not hike to the top of Mt. Houraiji, but if you feel like going on a relaxing day trip, I definitely recommend to go to Shinshiro and enjoy the mountain scenery, the momiji, and hike of Mt. Houraiji.

Group Photo by Ryan Flaminiano, Shinshiro-shi.Mr. De Schepper Karel is in the back row, fifth from the left.

# 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. 14* that was published on-line in February 2014.

The original *Toyohashi Tech e-Newsletter No. 14*: http://www.tut.ac.jp/english/newsletter/

The contents of The *Toyohashi Tech e-Newsletter No.15* include:

## Features

- President Takashi Onishi outlines his plans to create a multicultural and intellectually active campus at Toyohashi Tech

## News

- President Takashi Onishi delivers inauguration address
- Global visibility advertisement on new research program published in Science Magazine
- International Student Workshop: Towards Success as Global Engineers

## Research Highlights

- Development of the world's strongest magnesium alloy
- Waveguiding and detecting structure for surface plasmon polaritons on silicon
- Insights into physiological mechanisms underlying symptoms of aging
- Brain regions sensitive to facial color processing

## Club Activities

- Toyohashi Tech Badminton Club

## Excursions

- Daniel Ortega, visiting researcher at EIIRIS, September to October 2013
- Internship in Penang, Malaysia

### Editorial Committee



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