World Center of Education and Research for Trans-disciplinary Flow Dynamics

Official Site
http://www ifs.tohoku.ac.jp/gcoe/index-e.html
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Tohoku Univ. has grown up to the global leading center for fluid dynamics studies through the accumulated conferences for six years supported by GCOE program.

Attendees for the 56th International Conference on Flow Dynamics, which was chaired by Professor Junichi Mizuno, Tohoku University, were 408 researchers and students from 17 countries, which was about 150 more than that of last year. I am very much proud of the fact that this conference to now well recognized as a world top-class academic conference in fluid dynamics.

We had Japan-China Dialogue Symposium this year too. This session has a history of 16 years supported by sincere efforts by two professors, Professor Mizuno of Tohoku University and Professor Yoon of Seoul National University, and also by the students of the organizing committee of the two universities. The purposes of this session are to provide the students with fertile opportunities to know each other and nurture friendships, to discuss and understand in depth the research activities conducted in the two countries, and eventually to grow up as researchers to take world leadership in this very fundamental and essential field of fluid dynamics.

One of the new trials of this year is the Alumni Session. Main purpose of this session was to offer the alumni of Tohoku University, who once studied as professors, graduate students, post-doctoral and/or visiting scientists, at Tohoku University including Institute of Fluid Science, the chance to get together and exchange information by presenting and listening to the presentations on their current works. We received 23 alumni researchers from the countries and district as Taiwan, Russia, China, India, USA and Japan. The alumni once shared and nurtured an important time, place and occasion for their career building-up at Tohoku University. I am very glad by knowing that they have enjoyed and been inspired a lot by the reunion. Future cooperation and collaboration between the alumni may also be expected. We are planning to construct a comprehensive Alumni Data Base, and through the network, we will communicate and distribute many important and cutting edge information in fluid dynamics.
Tohoku University Global COE Program
Sixth International Conference on Flow Dynamics
November 4-6, 2009
Hotel Metropolitan Sendai, Sendai, Japan
ICFD2009 Program

Wednesday, November 4, 2009

Opening Address
Plenary Lectures
Hybrid Renal Preparation and Retained Fluid Dynamics
Energy and Environmental Systems over Nano/Meso/Macro Scales
Nanotechnology Workshop (METI-2006)
The Fifth International Students/Young Birds Seminar on Multi-scale Flow Dynamics
The 50th Japan-Korea Students’ Symposium-Fuel Transp in Solids and Through Interfaces - The Related Materials and Phenomena -
Current Topics in Flow Dynamics
Students/Young Birds Friendship Night

Thursday, November 5, 2009

Functional Design of the Central Dynamics
Advanced Control of Smart Fluids and Fluid Flows
IP3 Collaborative Research Forum (METI-2009) & IP3 Research Exhibition (METI-2006)
The Fifth International Students/Young Birds Seminar on Multi-scale Flow Dynamics
The 50th Japan-Korea Students’ Symposium-Fuel Transp in Solids and Through Interfaces - The Related Materials and Phenomena -
Current Topics in Flow Dynamics
IGCFE/HTS-Tokyo University Joint Workshop 2009
Luncheon Office Session

Friday, November 6, 2009

Advanced Control of Smart Fluids and Fluid Flows
The Fifth International Students/Young Birds Seminar on Multi-scale Flow Dynamics
The 50th Japan-Korea Students’ Symposium-Fuel Transp in Solids and Through Interfaces - The Related Materials and Phenomena -
Alumni Session

For starting off the conference, three distinguished scientists from USA, Korea and Japan gave plenary lectures on recent developments in fluid science and flow dynamics.
Rongjia Tao
Professor, Temple University, USA

Rheology for Efficient Energy Production and Conservation

Presently, most of our energy comes from liquid fuels. The viscosity plays an important role in liquid fuel production, transportation, and conservation. For example, reducing viscosity of crude oil is the key to transport Athabasca oil via deep water pipelines and to extract oil from oil sands. Currently, the dominant method to reduce viscosity of complex fluid is to raise its temperature. This does not only require much energy, but also raises concerns of the greenhouse effect. Based on the basic physics of viscosity, we recently developed a new technology to reduce the viscosity by changing the rheology of complex fluid with electric or magnetic field. The method is energy-efficient, universal and applicable to all complex fluids with suspended particles in nanometers, sub-micrometers, or micrometers. We have applied this technology to crude oil, bio-diesel production, and refinery fuels. The results are significant. Electric or magnetic field can reduce the viscosity of asphalt-based or paraffin-based crude oil significantly. We also used electric field to reduce viscosity of diesel fuel and improved the engine efficiency. While this technology is still at early stage, it shows its tremendous merit for energy production, energy transportation, and energy conservation.

Han-Ill Yoo
Professor, Seoul National University, Korea

An Odyssey to Experimental Verification of the Onsager Reciprocity in Flow of Charged Particles in Solids

Onsager’s reciprocity theorem is a key postulate of irreversible thermodynamics. Onsager originally derived it for the causality between flows and forces that are scalar in character. It was later clarified that the reciprocity theorem is verified (irrecoverably for those of vectorial character as well) but experimental demonstration of the reciprocity has remained by no means trivial for the vectorial processes in solid state in particular. Thus, the overall conclusion is still the observational relevance is overwhelming in favor of the validity of the reciprocity and it has not been disproved by experiments.

Through a long odyssey to experimentally verify the reciprocity, we came to measure the electron-optical cross-effect to find that the effect is by no means negligible depending on the thermodynamic state of a system, but ever failing to demonstrate the reciprocity. It is only recent that to be able to reach the reciprocity.

The Onsager reciprocity is finally confirmed in the phenomena of mixed ionic electronic conduction with unexpected precision. L/S = 0.9525 ± 0.001. And the cross coefficient can be even larger than the direct coefficient with many implications in treating charged particle flows in condensed systems.

Furthermore, it is noted that the cross-effect is indeed by no means negligible compared to the direct effect. L/S becomes even larger than L/S, which will have far-reaching consequences.

Seiji Samukawa
Professor, Tohoku University, Japan

Ultimate Nanofabrication Technology by Neutral Particle Beam

Recent Ultra Large Scale Integrated Circuits (ULSI) technologies require fabrication of sub-45nm patterns on Si-wafers. High density plasma sources, such as inductively coupled plasma (ICP) and electron cyclotron resonance plasma (ECR), are key technologies for developing precise etching processes. There are, however, potential risk factors involved in application of these sources, such as charge buildup by accumulating positive ions, and defect generation by radiation of ultraviolet (UV), vacuum ultraviolet (VUV), or X-ray photons during the etching processes.

The voltages evolved by such charge buildup cause distortion of ion trajectories, breakage of thin gate dielectric films, and pattern size dependence of etching rate. Additionally, high-density crystal defects may be generated by irradiation of UV or VUV photons to the etching surface. These problems must be overcome in the fabrication of future nano-scale devices.

Our group has developed a highly efficient neutral-beam source to accomplish the ultimate top-down etching for future nano-scale devices. In the presentation today, I touched upon the issues involved in the conventional plasma etching processes and introduced an ultimate type of etching process for future devices, of from 50 to sub-10 nm, by using our new neutral-beam sources. With this introductory part, Professor Samukawa started his lecture and introduced his new neutral-beam source for ultimate nanoscale etching process for 20 and sub-20 nm CMOS devices, and for defect free sub-10 nm Si nano-column etching.
Tenth Japan-Korea Students’ Symposium was held as a part of ICFD2009. This is the 10th anniversary of the Symposium, which has been held every year, in Seoul or in Sendai, alternately. Forty nine presentations by both Korean and Japanese students were made at the symposium this year.

A short discussion among the participants of the Japan-Korea Students’ Symposium

**Kyung-Ryul Lee**
Seoul National University, M.E, Korea

I participate consecutively in this symposium since the fifth one in Seoul in 2004. So, I know most of the students joined from Korea and Japan this year. Professor Yeo and Professor Mizuno started this symposium 10 years ago. In Seoul, with 26 students participated from the two countries. Now we have about 10 study groups and fifty students from the two countries attend the symposium this year. This is a wonderful symposium based upon wonderful ideas.

**Jung In Yeon**
Seoul National University, M.E, Korea

I find there is not so big difference between Korean and Japanese students. We are in same generation and in same research area. For example, the numbers of women participants are two from Korea and two from Japan. The presence of women in students society is still too small both in Korea and Japan. On the study sides, broad studies on electronic materials are implemented in Tokyo University. Seoul University focuses on particular electronic materials, such as electron material. This complementary relation on research is a good basis for collaboration. Participants can learn more from other side’s studies.

**Anna Suzuki**
Tokyo University, M.E, Japan

This is the first participation for me and the biggest problem for me was English. I decide to allocate more time to learn hearing and speaking of English because we need English to have good communication. For me it seems Korean students are more positive to discuss. This must come from the fact that they are better English speakers.

**Yasuhiro Fukuda**
Tokyo University, M.E, Japan

That’s right. The idea of a symposium “of the student, by the students, for the students” is wonderful. This session gave me a good opportunity to get social experience and general knowledge which students in class room tend to lack. I learned about military service obligation for men in Korea first time here from a Korean student. I recognized that I was too ignorant on important facts of the world. From this symposium, I learned both academic and social matters.

**Lee****

It is a good contrast to Seoul which is a dynamic and noisy city. I feel I am relaxed in Sendai. Sendai is my second home city now. Lee gave me a smile at the end of one’s sleeve to say so.
Professor’s talk between Junichiro Mizusaki and Han-III Yoo

Everything started from a chat 10 years ago.

Mizusaki: The idea of this Japan-Korea Students’ Symposium came out in a chat between us 10 years ago when Prof. Saito stayed at Tohoku Univ. as a visiting professor. He joined the weekly seminar at my laboratory and discussed with the Japanese students on the research and investigation of my laboratory. One day after the seminar, he said to me, “I will be more efficient if we can discuss together with my students.” I also felt the same when I made a decision on our recent investigations and experimental methods to Korean students as a visiting professor. I stayed in the previous year. Starting from this conversation, the basic idea for this Japan-Korea Students’ Symposium was made, where professors and students from both sides gather at the same place and present their talks and have discussions.

Symposium of the students, by the students, for the students.

Yoo: We were very fortunate because we could get financial support from in Korea and in Japan, and from the students’ center. The most important thing we considered at the first time was the selection of the students. Organizers selected students from both sides and they themselves set up the contents for the symposium via e-mail correspondence. Then, they submitted manuscripts of presentations and invited the proceedings prior to the symposium. The students did the work by themselves. The main spirit of the second of the symposium is “of the students, by the students, for the students.” We are very proud of our students in that we have never failed to publish the proceedings up to this symposium, and I am sure that they will bring this tradition in future.

From silence to friendly academic gala.

Mizusaki: Looking back the past, silence was dominant at the first symposium. It was broken at the coffee break and lunch time at the second symposium and equal and equal discussion emerged at around the fifth symposium. Now, much more useful and better than the discussion in usual international academic conferences. New discussion is very active not only during the sessions but also at a chat time at evening and excursion after symposium. We have a tradition in our laboratories in both countries in which friendship has been grown beyond the walls of national border languages and laboratories. Newly joined students can easily and quickly get accustomed to it.

The thickness of the proceedings tells the history.

Yoo: The contents of this symposium are solid state physics and applications for energy and environment in particular. The young students in this academic area from Korea and Japan are now bringing up their friendship at their home. The symbol of this friendship are the proceedings for ten years of this symposium. These proceedings are full of both progress of studies and development of friendship.

The 5th Students/Young Birds Seminar

At the Students/Young Birds Seminar, 76 students from 10 countries made presentations. Out of them, 31 came from other countries than Japan.

Organizer

Yasuhiro Saito

Tohoku University, D2, Japan

The students’ young bird session is organized by students themselves. Nothing can be done unless students do. For making a small bird party at the first sight of the seminar, we have taken the budget from the institution, and did the party fully prepared food and drink. We hope that all the students who came to the party enjoy the theme of the title.

Nothing is absolutely wrong. This seminar was a challenge for young students to design activities in particular areas. A presentation on chemical study came after a presentation on aerodynamics. We allocated presentations in this way because young students have lots of eyes to many more areas of science than elder students. We set up a list of topics for students with a choice of presentation topics. Many students from overseas and domestic students were interested in the presentation topics for their studies or the studies. Voluntary presentations were expected. Fortunately, I got an idea on my study or CFD related research for chemical industry. This gave me a big confidence to start a presentation in English at this seminar last year and I expected the repurchase of this session. What I got through these experiences was getting gap, speech at the presentation and getting ideas from overseas students gives me a substantial progress in my English ability! I also got some comfortable ability by repeating this seminar. Good experiences.

Xiaolei Wang

Tohoku University, MI, Japan

Today I presented my research on “Simulation of Fragmentation Reaction of Fuencendero Diynes by Using Quantum Chemical Molecular Dynamics (UADQNMD) Method.” I used a computer to simulate where the fragmentation points are within diynes molecules. This research has been developed by Miyama’s laboratory in our program. It was challenging to use UADQNMD method to simulate molecules, however, I got good results.

I am originally from Heilongjiang Province, China, which is colder than Taiwan. I hope to come back in China, and wish to contribute to the modernization after studying hard in Japan.

Farooq Ahmed

Tohoku University, D2, Japan

My presentation today is on “Influence of the Surface Hydrogen Vacancy for the Dissociative Absorption of HD on Pt (111) Surface.” In this study, we have demonstrated and examined successfully the individual steps of hydrogen dissociative absorption based on theoretical simulations of UADQNMD and using the HD and Pt (111) as a prototypical model. Our study clearly demonstrated that dissociative absorption of HD requires at least three or more hydrogen vacancies on Pt (111) surface. These results agree very well with previous experimental and theoretical results. This research is related to hydrogen storage, which plays an important role in base technology for fuel cell development. Study of both of hydrogen storage and HD absorption is very important for future energy-related technology, environment and industry. I am proud of my current research.

Khoshed MD Alam

Tohoku University, D2, Japan

My presentation today is on “Ultra-Accelerated Quantum Chemical Molecular Dynamics Study of Surface Production Process of CO2(111) and CO2(111) by H2.” I used UADQNMD, originally developed by Miyama’s laboratory, to find out the behavior on the surface. Hydrogen that reacts with high energy are absorbed on the surface, which breaks up oxygen atoms from the surface and results in the formation of CO2(111) and CO2(111) as an important catalyst material used for various purposes, such as automotive exhaust catalyst. Oxygen exchanges the oxidation of hydrocarbons and CO2 and decomposition of alcohols and aldehydes. Catalysis is widely used. Rounding the details of its reaction dynamics is very important for industry and environment.

I started my study at Tohoku University two years ago after graduating from Dhaka University in Bangladesh. Had I not come to this country, I would not have had such a chance. I am very happy. I am very happy with my current research and I am very happy with the future research and future studies as well. I would like to contribute to the advancement of science by becoming an independent scientist in the future.

Makoto Mori

Tohoku University, M2, Japan

The presentation I made today is on “Estimation of Kinetic Parameters of Polymer/Polymer in High-Temperature Air Combustion Combining Dilution and Numerical Analysis.” Characterization of pyrolysis and combustion of polymers in a stagnation point flow were investigated experimentally and we proposed a new method to estimate the kinetic parameters of polymer pyrolysis combining experiments and numerical analysis. The regression rates were calculated using the kinetic parameters obtained by this method were good agreement with experimental ones, indicating the high feasibility of this method. This study is an important basic research for the conservation of our environment because the air pollution will be applied to the pyrolysis and combustion of polyethylene and polypropylene.
The Alumni Session was organized for the first time in this conference. One of the main purposes of this session is to provide opportunities to Tohoku University Alumni to introduce each other of their current research and other activities at their working universities and institutions. We expect this session will enhance the activities like collaborative studies and student exchanges in future.

Goro Obinata  Professor, Nagoya University, Japan

Based upon the studies at former Institute of High Speed Mechanics (now IFS),
I am on a leading position to develop a strong tie between industries and academy in Nagoya University.

James W. Gregory  Assistant Professor, The Ohio State University, USA

Recent Development of Unsteady Pressure Sensitive Paint Technology

I stayed for several weeks in Sendai in summer of 2006 as an International Internship Student supported by the JICOE program. I studied at Professor Ken-ichiro Aida’s laboratory on porous binder used for pressure sensitive paint. A part of the results of my presentation at this conference “Recent Development in Unsteady Pressure Sensitive Paint Methods” was obtained at the time of my stay at Tohoku University. In that sense, the stay in Sendai contributes to the building-up of my professional career. Pressure sensitive paint (PSP) is a paint which shows the changes of brightness with the change of air pressure. Professor Aida and his laboratory people carried out an interesting experimental test to place a rugby ball coated with PSP in wind tunnel under variable air flow. They observed and recorded the change of brightness of certain location of the surface of the ball with the change of air velocity. That is not only scientifically meaningful but a big fun to us all. This PSP technology is expected to help aircraft design engineering very much in a near future. It was an exciting experience to stay in Sendai. Before that time, Tokyo was the only city I ever visited in Japan. Once I came to Sendai, however, I was really enchanted by Sendai and Tohoku University. I was impressed particularly by the activities and accomplishments achieved at the Institute of Fluid Sciences (IFS), by the professionals who came from different fields with different capacities, IFS, by back to back assignment as the JICOE and the GCOE programs by MEXT, is further empowered to produce recent outcomes in trans-disciplinary flow dynamics. Ohio State University which I am now working for is located in Columbus, Ohio. Columbus is also a very beautiful city with Scioto River running through the city, as Hirame River runs through Sendai. The university owns an airport right next to the campus and we have several aircrafts used for research and other activities at the university. I hope I can manage some kind of collaborative studies between the two universities in future. The Alumni Session of this ICTOS08 gave really a great opportunity for me to deepen the friendship of us all, and to be inspired for new challenges in this interesting scientific field.
Liaison Office Session

Participants total: 347, Participants from overseas: 108 (18 countries)

Platforms for Education and Research for Trans-disciplinary Flow Dynamics are set on global basis. Forty seven Academic Exchange Agreements with universities and research institutions of twenty countries, six Liaison Offices and International Joint Laboratories stimulated and promoted to generate many international collaborative research projects, many international conferences and symposia, intense activities as student exchanges by International Internship Program, and a strategic project as Tohoku-Lyon Summer School 2009.

Toshiyuki Takagi
Professor, Tohoku University
Program Sub-Leader, Tohoku University Global COE Program: World Center of Education and Research for Trans-disciplinary Flow Dynamics

A meaningful international conference where world top class research outcomes are presented, substantially discussed and developed for the future

Since the beginning of the 21st Century COE program, we have established 47 academic exchange agreements with universities and research institutes in twenty countries in the world. Furthermore, we have been very positive to establish liaison offices and joint laboratories globally. Three efforts resulted in the numbers of the researchers visited to this conference from overseas. The “International Conference on Flow Dynamics” has got a great result for Tohoku University to seek for being the “New International Collaborative Research Center.”

Our assets are affluent research exchanges with many universities and institutes. This conference is very meaningful where world top class research outcomes are presented, substantially discussed and developed for the future. Researchers will be stimulated by other researchers’ studies with new ideas and make progress in their studies. They can grow through attending this kind top level academic conference. What is necessary is to come together and discuss. Our multistage network we brought up for a long time is the suitable asset to realize this goal. The studyaura true useful outcomes upon the continued effort from past to future. This continuity is the decisive measure to get power.

We believe we are the only one research institute which has a consistent research system from basic to application in the area of fluid dynamics. We are aiming to be the only one research institute of the “New International Collaborative Research Center.” We discovered about the establishment of new summer school concept based upon multi-stage network supported by the bulletin office system. We decided to keep discussion on this matter meeting for having summer schools on next year of 2010. Our eyes look further ahead. We have got new inspirations first class presentations and discussions provided this international conference. We share the hope to have better research outcomes and discussions in the next year’s conference. This hope is the resource of development of research and ultimate significance of maintaining this conference.

Our mission as researchers is how far can we reach in our research and progresses can be made until next conference.

To Be Continued............