Japan
Member of ICHMT, AIHTC, AUTSE
(1) Overview

(Japan Standard Time, JST: UTC+9, Population: 125 million)

1. Major Societies

Most of Japanese scientists and engineers in thermal science and engineering (or more specifically heat and mass transfer) belong to the Heat Transfer Society of Japan (**HTSJ**), Thermal Engineering Division of the Japan Society of Mechanical Engineers (**JSME-TED**), and Division of Thermal Engineering of the Society of Chemical Engineering (**SCEJ-DTE**). The relationships among the three major societies are expressed as shown in **Fig. 1**. Although the number of members of HTSJ are much less than that of JSME-TED, HTSJ is a core society of heat and mass transfer. This is because JSME-TED consists of a wide variety of thermal engineering applications.

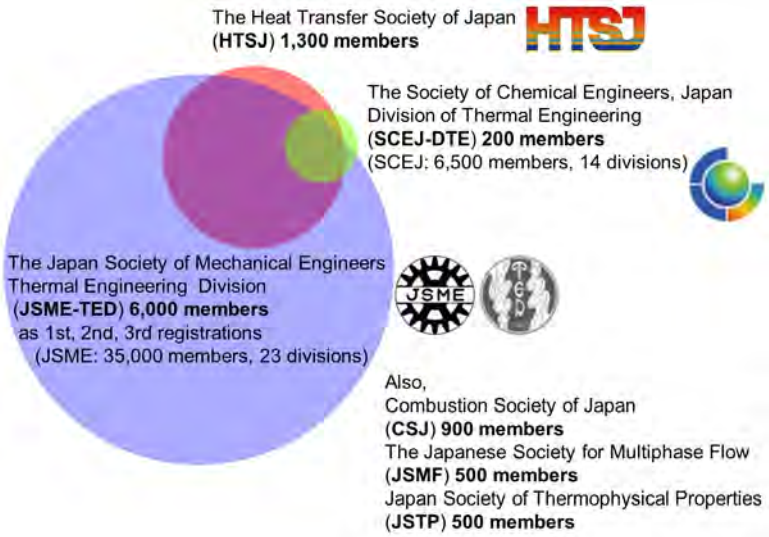


Fig. 1 Relationships among three major societies of thermal science and engineering

2. Major Meetings

National Heat Transfer Symposium by HTSJ
- Since 1964, annually held (the 58th in 2021)
- Place: rotated among 8 branches (see **Fig. 2**)
- Period: three days in late May or early June
- Participants: about 800
- Paper presentations (oral): about 350

Thermal Engineering Conference by JSME-TED
- annually held
- Period: 2 days in October
- Place: University campus

Thermal Engineering Session by JSME-TED
- during Annual Meeting of JSME (in September)
- Place: University campus

Fig.2 Eight branches of HTSJ

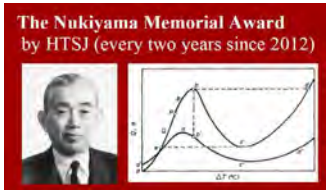
Thermal Engineering Session by SCEJ-DTE
- during Annual Meeting of SCEJ (in March)
- during Autumn Meeting of SCEJ (in September)
- Place: University campus

3. Major Journals

JSME
- The Journal of Thermal Science and Technology (JTST) (in English, every 4/6 months)
- Mechanical Engineering Journal (in English, bimonthly)
- Transactions of the JSME (in Japanese, monthly)

SCEJ
- Journal of Chemical Engineering of Japan (in English, monthly)
- Kagaku Kogaku Ronbunshu (in Japanese, bimonthly)

HTSJ
- Thermal Science and Engineering (in Japanese/English, quarterly)



4. Education (Undergraduate/Graduate School)

- Elementary School, 6 years; Junior High School, 3 years; High School, 3 years; Undergraduate School, 4 years. After Junior High School, there is an alternative choice of College of Technology, 5 years.
- In general, the first semester starts in April (cherry blossom season), while the second semester starts in October.
- Most of undergraduate school education is carried out by using Japanese textbooks.
- Senior students engage in bachelor theses by doing experimental/theoretical studies under his/her supervisors.
- Master course is usually 2 years, and Doctor course is 3 years on average.
- The deadlines of theses of (doctor,) master and senior students are usually in January or February.
- Traditionally, female students are not so many in the faculty of engineering, which is an urgent matter for us.

5. University System

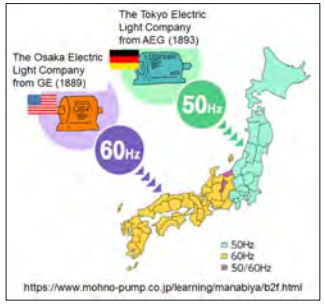
- Some laboratories are based on the chair system such as professor, associate professor, and assistant professor.
- Recently, however, laboratories based on the independent system are increasing.
- At most of universities, the retirement age is about 65.

6. Foundations of Scientific Research

- Ministry of Education, Culture, Sports, Science and Technology (MEXT)
- The Japan Society for the Promotion of Science (JSPS)
- Japan Science and Technology Agency (JST)
- New Energy and Industrial Technology Development Organization (NEDO)

7. Major Public/Private Research Institutes

- National Institute of Advanced Industrial Science and Technology (AIST)
- RIKEN (the Institute of Physical and Chemical Research)
- Japan Atomic Energy Agency
- Toyota Central R&D Labs., etc.



By-product of "war of the currents"

8. Addendum

Japanese language belongs to Altaic languages; one of their typical features is a subject–object–verb (SOV) structure. After Chinese characters were transferred to Japan in the 4th century, Hiragana and Katakana (Japanese characters) were developed in the 8-9th century. As a result, we combinedly use the above three characters as shown in this example.

President of HTSJ	MUNAKATA Tetsuo 宗像 鉄雄	t.munakata@aist.go.jp
President of JSME-TED	OHARA Taku 小原 拓	ohara@ifs.tohoku.ac.jp
President of SCEJ-DTE	KOBAYASHI Nobusuke 小林 信介	nsuke@gifu-u.ac.jp

Japan, Member of ICHMT, AIHTC, AUTSE (2)

1. Accelerating international collaboration with DX
Junichiro Shiomi

2. Report on 59th national heat transfer symposium of Japan (NHTSJ 2022)
Yoshinori Itaya and Hirofumi Hattori

1. Accelerating international collaboration with DX

Junichiro Shiomi, Dept. of Mech. Eng., The University of Tokyo
shiomi@photon.t.u-tokyo.ac.jp http://www.phonon.t.u-tokyo.ac.jp/?lang=en

The pandemic took a heavy toll on the world, forcing us to change the way we work, learn, and interact with others. It has been difficult time for the international academic community as well, as many of our scheduled events had to be cancelled or postponed. While there was disappointment and confusion, especially in the initial phase of the pandemic, it was encouraging to see that the academic societies immediately rose to the occasion and organized international conferences online, not only as an alternative to on-site but also to add values to the conferences with the help of digital transformation (DX). Such was the case with the international heat transfer community. Some of the online conferences I attended might have been difficult to achieve prior to DX. One example was "*International Colloquia on Thermal Innovations* (*InnoTherm*)" series (http://meche.mit.edu/international-colloquia-thermal-innovations) organized by the colleagues at MIT (chaired by Prof. Gang Chen) aiming to stimulate and highlight innovations and advances in thermal energy conversion, storage, transport, and utilization. I had a pleasure to moderate a couple of sessions and was thrilled to see hundreds of participants from around the world vividly discussing across different disciplines.

Learning the usefulness of DX to discuss new interdisciplinary topics, Prof. Chris Dames (UC Berkeley), Prof. Tengfei Luo (University of Notre Dame), Prof. Koji Tsuda (University of Tokyo), and I organized "*NSF-JST Joint Workshop on Thermal Transport, Materials Informatics and Quantum Computing*" (https://aithermworkshop.nd.edu) in March 2021. The workshop aimed to initiate conversations between the greater machine learning, materials informatics, quantum computing community and the thermal transport community to promote international collaboration initiatives. Over the past few decades, research in thermal transport has led to significant advancement in the understanding of fundamental physics and computational tools that can predict thermal properties with high fidelity. However, applying such established knowledge and tools to design new materials for relevant applications had been rather ad-hoc. With the recent prosperity of artificial intelligence (AI) and quantum computing, there is an opportunity to leverage them to further advance thermal transport fundamental science and maximize the ability to systematically develop thermal materials and processes with desirable performance. With this in mind, we invited speakers on four topics: data infrastructure; simulation-aided materials informatics and thermal transport; AI-driven experiments; and quantum computing. The dialogue between researchers within and between each topic was very productive. Constructive discussions were also held with other stakeholders such as governments and funding agencies. The workshop output several important action plans, including a computational round-robin study, thermal transport property database, and international autonomous experimentation, which initiated the on-going world-wide collaborations including researchers from Europe and China. Such a simultaneous multi-stakeholder dialogue would have been difficult without the DX.

Of course, online events have their drawbacks. Time zones have been a major issue, especially for international conferences. Many of us have given or heard a talk in the middle of the night fighting sleepiness. Recently, there have been hybrid conferences, where the on-site and online events are held on different days, but in such cases, the online portion is usually rather empty. Now that, in many places, the on-site events are restarting, we are re-recognizing how precious it is to meet and discuss in person. In fact, we had so much fun in the recent *National Heat Transfer Symposium of Japan* held on-site (reported on the next page)!

While I very much look forward to the resumption of international heat transfer conferences on-site, an important question may be "Are we going back to where we were before the pandemic?" or "Are there ways to improve on-site international conferences utilizing DX?" The world is now facing a sustainability crisis and there are growing expectations for academia to help solve it. Not to mention, the potential contribution from the field of heat transfer is significant, and the issues need to be tackled internationally. Such social demands have been always there, but the urgency is more than ever with critical timelines, which calls for efficient international collaboration rather than competition. That requires more in-depth discussion in the international conferences, but how do we

do it? One idea is a "flip conference". Like the "flip class", DX schemes could be used to provide participants with digital contents of presentation in advance so that they can spend more time for discussion on site. This can help the participants understand better each other's work and facilitate actual collaboration. Perhaps now is a good timing to think about transforming international conferences?

2. Report on 59th national heat transfer symposium of Japan (NHTSJ 2022)

Yoshinori Itaya Dept. of Mech. Eng., Gifu Univ., yitaya@gifu-u.ac.jp
Hirofumi Hattori Dept. of Mech. Eng., Nagoya Inst. of Tech., hattori@nitech.ac.jp

NHTSJ 2022 (https://htsj-conf.org/symp2022/index_e.html) took place in face-to-face and on-line virtual ways during May 18 to 20, 2022 in Gifu (Tokai district). Totally 338 papers were presented including 9 keynotes through 30 sessions in the symposium. The share of number of the presentation in each session is seen in **Fig. 2.1**. *The Best Presentation Award Session* is a poster session presented by young researchers and students, and 6 candidates were awarded. The awarded researches were 1) 3D analysis of heat transfer in human body core, 2) molecular structure and affinity at inorganic solid/polymer interface, 3) heat transfer of latent heat storage pellets for high temperature, 4) solid-solution photon upconversion crystal for improving solar energy utilization efficiency, 5) spin caloritronics by sensitive lock-in thermoreflectance of thermochromic liquid crystal, and 6) visualization of heat transport in oscillating heat pipes by neutron radiography. The top 3 sessions in which there were the most presentations were "*hydrogen, fuel cell, secondary battery*", "*boiling and condensation*" and "*understanding and control of droplet/wetting phenomena*". The trends reflect recent needs to innovative R&D on greatly efficient energy conversion and conservation technologies for establishing carbon neutral system. Additionally, heat and mass transfer phenomena are faced to complicated systems including multiphase flow, phase change, catalytic and non-catalytic reactions, electrochemistry, electromagnetic, vibration, nano-scale dynamics etc. In the session "*workshop on HTSJ promoted research*", the research activities of groups admitted in HTSJ were reported on the following topics in this year: 1) heat transfer using microsensors and/or devices, 2) heat and physical environment in bio-cells, 3) heat transfer for solar energy utilization and 4) turbulence heat transfer, combustion and pioneer of complex fluid for future energy system. Those researches are expected to be greatly promoted and progress under funding for an innovation of heat transfer in a near future. The session of "*introduction of component and technology development by companies in Tokai district*" opened under the organization by researcher/engineers in industrial sector. Tokai district is one of the largest industrial area in Japan, and several fields of industry, i.e. automobile, machinery, steel, chemical, petrochemical, energy, ceramics, aerospace etc. are concentrated and yield the greatest percentage of Japanese GDP. Four local companies introduced their technology on 1) low density silicon thermal interface material, 2) thermal design of printing products and electronic parts, 3) compact and light heat exchanger for vehicles and products working with low power, 4) application of 1DCAE into thermal design. In this symposium, mutual exchange through earnest discussion were actively performed and could be closed successfully although face-to-face meeting had not been held for three years due to COVID-19 pandemic.

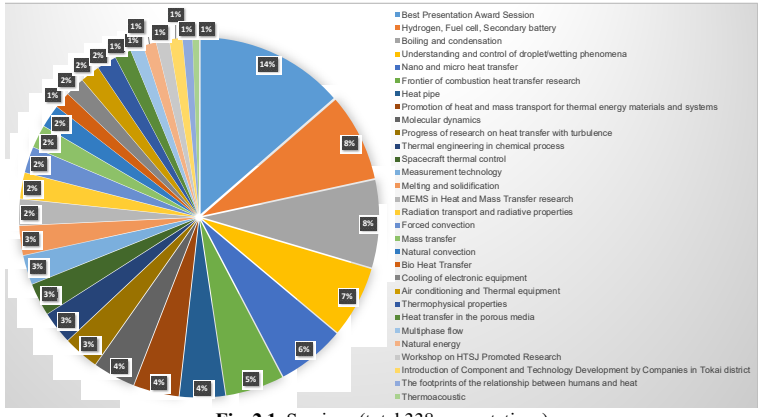


Fig. 2.1 Sessions (total 338 presentations)