INTRODUCTION

The 8th U.S.–Japan Joint Seminar on Nanoscale Transport Phenomena was held 14–16 July 2014, in Santa Cruz, California. This conference series is held once every three years and alternates between the United States and Japan. These meetings have a history of bringing together diverse perspectives from the nanoscale heat transfer community: United States and Japan, senior and junior researchers, experimentalists and modelers, fundamentals and applications. By tradition it is a single-track meeting, with time for discussion and reflection.

The 2014 meeting was attended by 105 researchers. Among these, 51% were university faculty, 9% were other professional researchers (industry, national laboratories, and government program managers), and 40% were graduate students and postdoctoral researchers. The international breakdown was 70% United States and 30% Japan.

The meeting was supported by the U.S. National Science Foundation (Dr. Sumanta Acharya) and the Japan Society for the Promotion of Science, both of which have a long history of support for the U.S.–Japan seminar series. Additional support was received from Seagate Corporation (Minneapolis, MN) and Western Digital Corporation (Fremont, CA).

The meeting ran for two and a half days and included 11 technical sessions, two general/plenary sessions, a panel, a poster session, and an excursion. The technical sessions (see online supplementary materials) included such mainstays as heat conduction in nanostructures, energy conversion phenomena, fluidics and reactions, and applications in...
thermal management and thermoelectrics. However, in recent years we have perceived a growing hunger from the community for new directions: techniques, materials, and, probably most of all, new real-world applications to guide the more fundamental pursuits. For this reason, we endeavored to invite researchers from less-familiar industries and research communities, whose fundamental interests nevertheless overlap with nanoscale transport. Examples of this ranged from cellular biology to neutron scattering and data storage. Indeed, this was the very first U.S.–Japan meeting for more than one third of the faculty and professional researchers in attendance.

As organizers we continued many longstanding strengths of this series, while also introducing several novel elements. Nearly all of the talks were recorded by video and are now publicly available online. Another experiment for 2014 was the administration of an anonymous survey, with a response rate of around 50% of the attendees. The primary goal was to quantify and document the state of the field. Here there is only space here for a few highlights, but the complete survey results including comments are available in the online supplementary materials and may offer some interesting reading for workers in this field. It surely would be insightful to revisit this snapshot in a decade’s time.

SURVEY HIGHLIGHTS

Researchers were asked to identify some of the most important advances in their field over the past 12 years. Certain common themes emerged, although it must be noted that these, of course, reflect the experience and awareness of the respondents themselves. Modeling comments frequently identified first-principles calculations of thermal conductivity as a major advance since 2002. Many respondents also noted experimental advances such as transport measurements of individual nanostructures, ultrafast thermoreflectance methods, near-field radiation, and phonon fundamentals including coherence phenomena and mean free path spectroscopy. Thermoelectrics was often named as a major materials driver over the last decade.

Respondents also looked ahead 12 years, attempting to identify new grand challenges and opportunities. Their visions of the future were even more diverse than their assessments of the past, and interested readers are encouraged to review the full range of comments for themselves (see online supplementary materials). Certainly both modelers and experimentalists see much more room to push their capabilities; for example, adapting first-principles modeling to complex materials and multiscale integration, and extending experimental spatial resolution to a single interface or even a single atom. Numerous emergent directions were also suggested. It is clear that this group of researchers remains deeply interested in conduction fundamentals, including wave and coherence effects, multicaerrier coupling, and nonlinear phenomena. Many respondents were concerned with identifying application drivers, especially those that might match the activity levels seen for thermoelectrics. Energy and microelectronics were common themes. Other visionaries noted potential for major impacts of nanoscale transport research on batteries, natural gas extraction, fresh water provision, and biology.

The survey also had a question about teaching. At the graduate level, 49% of respondents reported that their institutions offer one or more complete classes devoted to

1Videos available online at http://dameslab.berkeley.edu/USJ2014/videos.html.
nanoscale transport phenomena. Undergraduates are also being exposed to nanoscale transport, with 33% of respondents reporting its inclusion in at least part of an undergraduate course.

THE BIG PICTURE OF NANOSCALE TRANSPORT: CRITICAL OPINION PAPERS

The U.S.–Japan series has a tradition of summarizing each meeting with a conference report published in *Nanoscale and Microscale Thermophysical Engineering (NMTE)* [1, 2]. For 2014 we have instead chosen to solicit critical opinion papers. The general themes are similar to those of the meeting. But authors were specifically encouraged to consider their topic more broadly and provide their own critical analysis and opinions. We thank Professor Li Shi, the Editor-in-Chief of *NMTE*, for encouraging this approach, and we acknowledge the inspiration of a recent workshop on nanoscale phase change [3].

We close by encouraging you, the reader, to browse this Special Issue of *NMTE* with its unique collection of critical and authoritative papers. We hope that this will inspire you about the breadth of topics in nanoscale thermal transport, the impact of this field, and the opportunities for the future.

SUPPLEMENTAL MATERIAL

Supplemental data for this article can be accessed on the publisher’s website.

REFERENCES

1. T. Borca-Tasciuc, D.G. Cahill, G. Chen, S.B. Cronin, H. Daiguji, C. Dames, K. Fushinobu, T. Inoue, A. Majumdar, S. Maruyama, K. Miyazaki, M. Matsumoto, P.M. Norris, L. Shi, M. Shibahara, M. Shannon, J. Shiomi, Y. Taguchi, K. Takahashi, T. Tsuruta, S.G. Volz, E. Wang, X.F. Xu, B. Yang, and R.G. Yang, Report on 6th U.S.–Japan Joint Seminar on Nanoscale Transport Phenomena—Science and Engineering, *Nanoscale and Microscale Thermophysical Engineering*, Vol. 12, pp. 273–293, 2008.

2. B.A. Cola, H. Daiguji, C. Dames, N. Fang, K. Fushinobu, S. Inoue, G. Kikugawa, M. Kohno, S. Kumar, D.Y. Li, J.R. Lukes, J.A. Malen, A.J.H. McGaughey, O. Nakabeppu, K. Pipe, P. Reddy, S. Shen, L. Shi, M. Shibahara, Y. Taguchi, K. Takahashi, T. Yamamoto, and T. Zolotoukhina, Report on the Seventh U.S.–Japan Joint Seminar on Nanoscale Transport Phenomena—Science and Engineering, *Nanoscale and Microscale Thermophysical Engineering*, Vol. 17, pp. 25–49, 2013.

3. Y. Peles and E.N. Wang, Preface, *Nanoscale and Microscale Thermophysical Engineering*, Vol. 18, pp. 195–196, 2014.