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## International Journal of Heat and Mass Transfer

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In Celebration

## Dr. Prof. Wataru Nakayama on his 80th birthday



We are pleased to honor Doctor Professor Wataru Nakayama on the occasion of his 80th birthday. He was born on 7 January 1936 in Kamakura, Japan. He attended the National Defense Academy, where he received his B.S. degree in Mechanical Engineering in 1958. After serving three years as an aircraft maintenance officer at the Air Self-Defense Force, Japan, he started his heat transfer studies when he enrolled in the graduate school of Tokyo Institute of Technology (Tokyo Tech) in 1961, and received the doctoral degree in 1966. His thesis supervisor was Professor Yasuo Mori, one of the founders of the heat transfer research community in Japan. A series of doctoral studies on forced convective heat transfer in a pipe with secondary flows was published in *Int. J. Heat and Mass Transfer* during 1965–1971, and some correlations derived in the studies are known as the “Mori-Nakayama formulas.”

After finishing an additional one-year assignment as an engineering officer in the Defence Agency after receiving the doctoral degree, and gaining three years of experience as a researcher and a lecturer in universities in Canada, he joined Hitachi, Ltd. in 1970. At Hitachi he conducted and supervised heat transfer research for a wide range of products including electrical machines, heat exchangers, and computers. In 1989, he became the Hitachi Chair Professor at Tokyo Tech, a position he held until his retirement in 1996. At Tokyo Tech he taught and conducted research on microelectronic packaging with a focus on power

and thermal management of computers. After his retirement from Tokyo Tech, he served as a visiting professor at University of Maryland until 2001, where he supervised research on thermal management supported by DARPA’s HERETIC (Heat Removal by Thermal Integrated Circuits) program. During his years at the University of Maryland, he welcomed and hosted many Japanese researchers, with his wife Michiko, and devoted considerable effort to collaborating with one of the authors (Y. Joshi) on studies of energy management in data centers. Since returning to Japan in 2001, he has been working on “the reliability design of electronic equipment, in an industry/academia consortium” under the auspices of Japan Society of Mechanical Engineers and on “very-long micro channel cooling for computers of future generations” organized by the Heat Transfer Society of Japan.

Throughout his career Dr. Nakayama has successfully used the principles of heat transfer science and engineering to overcome various technological barriers facing the industry. He has also made significant contributions to the understanding of heat transfer processes in industrial equipment through the fundamental studies he conducted with his colleagues. He has been particularly active in thermal management of electrical and electronic equipment and in the enhancement of boiling and forced convection heat transfer. His first assignment at Hitachi was developing a cooling design for a large-capacity electric generator, in which he applied the analytical technique he developed during his doctoral thesis work at Tokyo Tech. The oil crisis in the early 1970s motivated his team of researchers at Hitachi to improve the design of evaporators and condensers used in refrigeration machines and led to the development of “THERMOEXCELS;” famous products for high heat-flux boiling and condensing surfaces. He developed analytical models to explain the mechanisms of enhanced boiling and condensing heat transfer on the structured surfaces of evaporator and condenser tubes and used the results of the analyses to optimize the surface structures. Since the 1980s and until today, the focus of his research has been on thermal management of electronic equipment. He participated in the research and development of cooling devices and systems for the mainframe computers of the 1980s. In recent years he has been advancing the methodology of thermal design analysis to aid designers of compact electronic equipment. His current research topics include hot spot occurrence in many-core processor chips, heat conduction in complex structures, and modeling of electrical-thermal coupled systems.

While working in industry, Dr. Nakayama was active in sharing the industrial needs for research with the heat transfer community

through publications, seminars, and lectures. Some of his review articles on thermal management technology published in ASME Applied Mechanics Reviews and elsewhere have served as tutorial materials for graduate students and engineers in the industry. A few of the authors of this article still remember vividly the overwhelming impact of his keynote lectures given in some international conferences, particularly, the lecture on 'Enhancement of Heat Transfer' at the 7th International Heat Transfer Conference in Munich (1982), which defined new directions in advanced heat transfer research. After he joined the academia, he continued his commitment to the development of the thermal management community through organization of conferences, editorial work on journal issues, and work in various committee. He co-organized the Japan-US Joint Seminar on 'Computers in Heat Transfer Science and Engineering' with Professor Kwang-tzu Yang in 1991. He co-chaired the InterPACK with one of the authors (A. Bar-Cohen) in 1995, and has participated in the evolution and growth of this conference series.

Dr. Nakayama served on the editorial board of various journals such as *Heat Transfer Engineering*, *International Journal of Heat and Mass Transfer*, *Journal of Enhanced Heat Transfer*, and *Experimental Thermal and Fluid Science*. The list of his administrative activities in the professional societies includes; President of the Heat Transfer Society of Japan (1994), Chair of the JSME Thermal Engineering Division (1990), Chair of ASME Japan Chapter (1990–1992), and executive committee member of the International Centre for Heat and Mass Transfer (1994–2002).

Dr. Nakayama has received many awards for his contributions to the advancement of heat transfer science and engineering as well as the development of the thermal management community, including: the best paper awards from ASME Heat Transfer Division (1981) and JSME (1965, 1980), the ASME Heat Transfer Memorial Award (1992), the ICHMT Fellowship Award (1996), the ASME Electrical and Electronic Packaging Division Outstanding Contribution (Thermal) Award (1996, now Allan Kraus Medal), the JSME Award for Longstanding Contributions to Mechanical Engineering (1997), the IThERM Achievement Award (2000), the InterPACK Achievement Award (2001), the Thermi Award (IEEE Semi-Therm, 2006), the JSME Funai Special Award (2007), the Max Jakob Memorial Award (2013). Dr. Nakayama is a Life Fellow of ASME, a Life Fellow of IEEE, a Life Member of JSME, and an Honorary Member of the Heat Transfer Society of Japan.

On behalf of Dr. Prof. Nakayama's colleagues and friends all over the world, we would like to wish him many years of continued success, good health, and happiness.

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Available online 24 September 2016