

**Seventh International Conference**

on

**Enhanced, Compact and Ultra-Compact Heat Exchangers:  
Science, Engineering and Technology**

**September 13-18, 2009**

**La Condesa Hotel  
Heredia, Costa Rica**

*Conference Chair*

**Ramesh K. Shah**

Indian Institute of Technology Bombay  
Powai, Mumbai, India

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Toyama Prefectural University  
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**SUNDAY, SEPTEMBER 13, 2009**

18:00 – 19:00	Registration (Foyer of the Emperador Conference Room)
19:30 – 21:00	Dinner (Patio Los Condes Restaurant)
21:00 – 22:00	Welcome reception (Emperador Conference Room)

**Notes**

- All technical sessions will be held in the Emperador Conference Room.
- Meals will be in the Patio Los Condes Restaurant with the except of Thursday's banquet which will be in the El Mirador de la Cava del Conde Restaurant
- Audiotaping, videotaping and photography of presentations are strictly prohibited.
- Speakers – Please leave at least 5 minutes for questions and discussion.
- Please do not smoke at any conference functions.
- Turn your cellular telephones to vibrate or off during technical sessions.
- Be sure to make any corrections to your name/contact information on the Master Participant List or confirm that the listing is correct. A corrected copy will be sent to all participants after the conference.

**MONDAY, SEPTEMBER 14, 2009**

07:00 - 08:00

Breakfast

08:00 - 08:10

Welcome and Introduction

08:15 - 10:15

**Session 1: RECENT DEVELOPMENTS IN HEAT EXCHANGERS STUDIES**

**Session Chair:**

**Keynote Lecture**

**Two phase distribution issues in microchannel heat exchangers**

P. Hrnjak

University of Illinois, Urbana, IL, USA

**Thermal-hydraulic performance and system-level effects of Al<sub>2</sub>O<sub>3</sub>-propanol nanofluid**

A. Sommers<sup>1</sup>, K.L. Yerkes<sup>2</sup> and A.R. Runyon<sup>2</sup>

<sup>1</sup>Miami University, Oxford, OH, USA, <sup>2</sup>Airforce Research Laboratory, Wright- Patterson AFB, OH, USA

**The potential impact of nano-fluid enhancements on the design of heat exchangers,**

L. Liu, E. S. Kim, Y. Park, and A. M. Jacobi,

University of Illinois, Urbana, IL, USA

10:15 – 10:45

Coffee/tea break

10:45 – 13:00

**Session 2: SINGLE-PHASE HEAT TRANSFER ENHANCEMENT- Part I**

**Session Chair:**

**Influence of the fin spacing on the flow field near the tube-fin junction in louvered fin compact heat Exchangers**

H. Huisseune<sup>1</sup>, C. T'Joel<sup>1</sup>, R. De Maeseneire<sup>1</sup>, P. De Jaeger<sup>1,2</sup>, M. De Paepe<sup>1</sup>

<sup>1</sup>Department of Flow, Heat and Combustion Mechanics, Ghent University, Belgium; <sup>2</sup>NV Bekaert SA, Kortrijk, Belgium,

**Mean flow behavior and resulting thermo-hydraulics of inclined louvered fins**

B. T'Joel, H. Huisseune, P. De Jaeger, A. Willockx, M. De Paepe

Department of Flow, Heat and Combustion Mechanics, Ghent University, Belgium

**A comparison of metal-foam heat exchangers to compact multi-louver designs for air-side heat transfer applications**

Z. Dai, K. Nawaz, Y. Park, Q. Chen, and A. M. Jacobi

University of Illinois, Urbana, IL, USA

**Foam heat exchangers: A technology assessment**

A. Muley, Koch Heat Transfer, USA,

B. Kiser, Honeywell Turbo Technologies, USA,

B. Sundén, Lund Institute of Technology, Sweden, and

R.K. Shah, Energy Science and Engineering Department, IIT Bombay, India

13:00 – 14:00

Lunch

14:00 – 16:00

Free time and *ad hoc* discussions

**MONDAY, SEPTEMBER 14, 2009 (continued)**

16:00 – 17:30

**Session 3: SINGLE-PHASE HEAT TRANSFER ENHANCEMENT- Part II**

**Session Chair:**

**Keynote Lecture**

**Flow field analysis of the air flowing through fin-and-tubes with Delta-Winglet Vortex Generator**

S.W. Hwang and J.H. Jeong

School of Mechanical Engineering, Pusan National University, South Korea

**Enhancement of heat transfer for fin-and-tube heat exchangers with Delta-Winglet Vortex Generators**

Y. G. Lei, Y. L. He and W.Q. Tao

Xi'an Jiaotong University, China

17:30 – 18:00

Coffee break

18:00 – 20:00

**Session 4: SINGLE-PHASE HEAT TRANSFER ENHANCEMENT- Part III**

**Session Chair:**

**Application of combined enhanced techniques for design of highly efficient air heat transfer surface**

J.F. Fan, Y.L. He, W.Q. Tao

Xi'an Jiaotong University, China

**Minimizing data reduction uncertainty during experiments with compact heat exchangers (oral presentation only)**

A.M. Jacobi

University of Illinois, Urbana, USA

20:00

Dinner

**TUESDAY, SEPTEMBER 15, 2009**

07:00 – 08:00

Breakfast

08:00 – 10:00

**Session 5: COMPACT HEAT EXCHANGER DESIGN AND OPTIMIZATION - I**  
**Session Chair:**

**Keynote Lecture**

**Approximation assisted optimization for compact heat exchangers**

O. Abdelaziz, V. Aute, S. Azarm, and R. Radermacher

Center for Environmental Energy Engineering, University of Maryland, USA

**Effectiveness-thermal resistance method for heat exchanger design and analysis**

Z. Y. Guo<sup>1</sup>, X. B. Liu<sup>1</sup>, W. Q. Tao<sup>2</sup>, and R. K. Shah<sup>3</sup>

<sup>1</sup>Tsinghua University, China, <sup>2</sup>Xi'an Jiaotong University, China, and <sup>3</sup>Indian Institute of Technology Bombay, India,

**Heat transfer and flow resistance correlations for louver fin surface**

H. C. Kang<sup>1</sup> and G. W. Jun<sup>2</sup>

<sup>1</sup>Kunsan National University, South Korea, and <sup>2</sup>Halla Climate Control Co., South Korea

10:00 – 10:30

Coffee/tea break

10:30 – 12:45

**Session 6: COMPACT HEAT EXCHANGER DESIGN AND OPTIMIZATION - II**  
**Session Chair:**

**Keynote Lecture**

**Reliability, availability, maintainability and safety (RAMS) of high-temperature compact heat exchangers**

J. Klemeš, L. Sikos and P. Varbanov

Faculty of Information Technology, University of Pannonia, Hungary

**Optimization criteria for heat exchangers with different applications**

Q. Chen<sup>1</sup>, J. Wu<sup>1</sup>, M. Wang<sup>2</sup> and Z-Y. Guo<sup>1</sup>

<sup>1</sup>Tsinghua University, China, <sup>2</sup>Los Alamos National Laboratory, USA

**Optimization of pin fin density at low Reynolds numbers in minichannels**

N.K.C. Selvarasu, Danesh K. Tafti, Neal E. Blackwell

Virginia Polytechnic Institute and State University, USA

12:45 – 14:00

Lunch

14:00 – 16:00

Free time for recreation or *ad hoc* discussions

16:00 – 17:10

**Session 7: FUNDAMENTAL STUDIES AND APPLICATIONS - I**  
**Session Chair:**

**Numerical studies on a novel shell-and-tube heat exchanger with combined helical baffles**

G.D. Chen, W. Wang and M. Zeng

Xi'an Jiaotong University, China

**TUESDAY, SEPTEMBER 15, 2009 (continued)**

**A simple effective viscosity formulation for turbulent flow and heat transfer in compact heat exchangers**

S.B. Beale

National Research Council of Canada, Canada

17:10 – 17:30      Coffee break

17:30 – 19:30      **Session 8: FUNDAMENTAL STUDIES AND APPLICATIONS - II**

**Modeling of air-side fouling in exhaust gas recirculators**

N. Krishnamurthy, Danesh K. Tafti and Aroon K. Viswanathan

Virginia Polytechnic Institute and State University, USA

**Microchannel Heat Transfer and Pressure Drop Performance: Single-Phase, Boiling and Condensation**

R.K. Shah, Indian Institute of Technology Bombay, Mumbai, India

20:00                      Dinner

**WEDNESDAY, SEPTEMBER 16, 2009**

07:00 – 08:00

Breakfast

08:00 – 10:00

**Session 9: SINGLE-PHASE HEAT EXCHANGER DEVELOPMENT & APPLICATIONS – I**

**Session Chair:**

**Keynote Lecture**

**Are compact heat exchangers suitable for high temperature applications?**

P. Stehlik

Faculty of Mechanical Engineering, Brno University of Technology, Czech Republic

**Keynote Lecture**

**Study and design of a new type of heat exchanger**

L. Cheng and W. Du

Institute of Thermal Science and Technology, Shandong University, China

10:00 – 10:30

Coffee/tea break

10:30 – 13:00

**Session 10: SINGLE-PHASE HEAT EXCHANGER DEVELOPMENT & APPLICATIONS – II**

**Session Chair:**

**Keynote Lecture**

**Research and development on heat exchangers for air conditioners with the alternative winglet,**

H. Fujino

Daikin Industries Ltd., Japan

**Heat generation characteristics in Si mosfets for the device-level thermal management—effect of the device scaling and transport properties**

Y. Yamamoto, T. Hatakeyama, K. Fushinobu and K. Okazaki

Tokyo Institute of Technology, Japan,

**Study on the heat sink performance for LSI packages using a thermo-siphon structure with PF-5060 refrigerants**

M. Ishizuka<sup>1</sup>, S. Nakagawa<sup>1</sup>, T. Hatakeyama<sup>1</sup> and T. Tomimura<sup>2</sup>

<sup>1</sup>Toyama Prefectural University, Japan, <sup>2</sup>Kumamoto University, Japan

**A capillary pumped two loop system for cooling of electronic devices**

B Schilder, W. Schuch, P. Stephan

Technical University of Darmstadt, Germany

13:00 – 14:00

Lunch

14:00 – 16:00

Free time for recreation and *ad hoc* discussions



**WEDNESDAY, SEPTEMBER 16, 2009 (continued)**

16:00 – 17:10

**Session 11: SINGLE-PHASE HEAT EXCHANGER DEVELOPMENT & APPLICATIONS – III**

**Session Chair:**

**Design and testing of one stage water gas shift reactors (OS-WGS) with integrated heat exchange functionality based on microchannel technology**

J. Schuerer, G. Kolb, M. O'Connell, D. Tiemann  
Institut für Mikrotechnik, Mainz GmbH, Germany

**Application of plastic microcapillary films (MCFS) as heat exchangers in low-cost solar energy collectors**

C.H. Hornung, C. Dorfling, B. Hallmark, R.J.J. Beaumont, H. Fovargue, M.R. Mackley,  
Department of Chemical Engineering & Biotechnology, University of Cambridge, UK,

17:10 – 17:30

Coffee break

17:30 – 19:00

**Session 12: SINGLE-PHASE AND PHASE-CHANGE HEAT EXCHANGER DEVELOPMENT & APPLICATIONS – IV**

**CFD studies on multi jet ejector configuration for improvement of aircraft compact heat exchanger performance**

L. Sheik Ismail, N. Govindha Rasu, Ch. Ranganayakulu, M.A. Ramaswamy Aeronautical Development Agency, India,

**Joule-Thomson micro-refrigerator with flexible regenerative heat exchanger**

M. Kohno, A. Widyaparaga, A. Tanabe, M. Kuwamoto, H. Kubota and Y. Takata  
Kyushu University, Japan

**Design and Optimization of Minichannel Parallel Flow Condensers**

B. Copetti, M.H. Macagnan, C.O. Figueiredo  
UNISINOS Sao Leopoldo – RS, Brazil

19:30

Dinner

## **THURSDAY, SEPTEMBER 17, 2009**

- 07:00 – 08:00 Breakfast
- 08:00 – 16:00 Optional Excursions with Costa Rica Dream Travel
- 16:00 – 18:00 **Session 13: Phase Change Heat Exchanger Development & Applications – Part I**  
**Session Chair:**
- Keynote Lecture**  
**Microbubble emission boiling for advanced compact heat exchangers**  
K. Suzuki  
Tokyo University of Science, Japan
- Influence of vortex generator arrays on thermal–hydraulic performance of compact refrigeration evaporators under frosting conditions**  
A. Joardar and A.M. Jacobi  
Carrier Corporation, USA; University of Illinois, Urbana, IL, USA
- Minimizing airside ventilation power in a plate-fin and single–row tube heat exchanger**  
R. Nacereddine, S. Russeil, D. Bougeard, A.G. Kanaris and J.-L. Harion  
Ecole des Mines de Douai, France
- 18:00 – 18:15 Coffee break
- 18:15 – 20:00 **Session 14: PHASE-CHANGE HEAT EXCHANGER APPLICATIONS – Part II**  
**Session Chair:**
- Results of estimation of rational enhancement process of convective heat transfer by passing a section through long smooth rectangular ducts**  
V.Y. Vasilyev and S.G. Vinokurova  
Astrakhan State Technical University, Russia
- Single and two phase heat transfer and pressure drop in a 0.52 mm vertical metallic tube**  
M.M. Mahmoud, D.B.R. Kenning, and T.G. Karayiannis, School of Engineering and Design, Brunel University, UK
- A new type of bath vaporiser for air separation units - An example of development management**  
M. Wagner and F. Fuentes  
Centre de Recherche Claude Delorme, Air Liquide, France
- 20:00 - 20:10 Future Plans and Vote of Thanks
- 21:10 Conference banquet

## **FRIDAY, SEPTEMBER 18, 2009**

- 07:00 – 08:00 Breakfast  
Departures