

## *Program*

# International Conference on Heat Transfer and Fluid Flow in Microscale

*Il Ciocco Hotel and Conference Center  
Castelvechio Pascoli (Tuscany), Italy  
Tel: +39 0583 719 Fax: +39 0583 723 197*

25-30 September 2005

### *Chair*

Dr. Gian Piero Celata, ENEA, Italy

### *Co-Chairs*

Prof. **Satish Kandlikar**, Rochester Institute of Technology, USA

Prof. **Nobuhide Kasagi**, The University of Tokyo, Japan

Prof. **John R. Thome**, Ecole Polytechnique Fédérale de Lausanne, Switzerland

### *Scientific Secretary*

Dr. Giuseppe Zummo, ENEA, Italy

# ECI

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Engineering Conferences International (ECI) is the successor program to the United Engineering Foundation conferences program that was established in 1962 to provide an opportunity for the exploration of problems and issues of concern to engineers from many disciplines. ECI is a not-for-profit partnership between the Engineering Conferences Foundation (ECF) and Polytechnic University.

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## **CONFERENCE OBJECTIVE**

The conference objective is to address the state-of-the-art knowledge in the field of heat transfer and fluid flow in microscale. Recent development of industrial applications like microelectronics, laser systems, micro-heat exchangers, micro-devices (sensors and actuators), and power MEMS have led to studies dealing with microscopic behaviour of thermal phenomena. The conference intends to provide a forum for scientists from academia and people from industry to present and discuss recent advances in their research on thermal phenomena in microscale.

## **NOTES FOR CONFERENCE PARTICIPANTS**

Participants should observe no smoking at ECI technical and social events.

During technical sessions please keep cell phones on vibrate or shut off. Take any telephone conversations out of the session room.

Presenters should leave time at the end of their talks for discussion.

**SUNDAY, SEPTEMBER 25, 2005**

17:00 - 19:30 Registration

18:30 – 19:30 Welcome reception

19:30 - 21:30 Dinner

**MONDAY, SEPTEMBER 26, 2005**

07:30 – 08:15 Breakfast

08:15 - 08:30 Welcome & Introduction

08:30 - 09:15 **Keynote lecture: TWO-PHASE FLOW AND BOILING IN MICROCHANNELS**

J.R. Thome

*Heat and Mass Transfer Laboratory (LTCM), Ecole Polytechnique Fédérale de Lausanne (EPFL), Lausanne, Switzerland*

*Keynote chair: Prof. N. Kasagi*

09:15 - 10:35 **Session: MEASUREMENT TECHNIQUES 1 – MT1**

*Session chair: P.C. Wayner*

**HOT-TUBE SENSORS FOR FLOW MEASUREMENTS**

V.M. Aniskin\*, A.N. Shipliyuk\*, A.A. Maslov\*, V.V. Pay\*, V.Ya. Prinz\*\* and V.A. Seleznev\*\*

*\*Institute of Theoretical and Applied Mechanics SB RAS, Novosibirsk, Russia,*

*\*\*Institute of Semiconductor Physics SB RAS, Novosibirsk, Russia*

**VISCOSITY MEASUREMENTS OF DNA SOLUTION IN A MICROCHANNEL UTILISING  $\mu$ -PIV AND PRESSURE MEASUREMENTS**

D.M. Curtin, D.T. Newport and M.R Davies

*Stokes Research Institute, University of Limerick, Ireland*

**MESOSCOPIC ANALYSIS OF ULTRA FAST LASER ABLATION**

Y. Yamashita\*, Y. Yamaguchi\*\*, T. Yokomine\*\*\*, S. Ebara\*\*\* and A. Shimizu\*\*\*,

*\*Department of Advanced Energy Engineering Science, Interdisciplinary Graduate School of Engineering Sciences, Kyushu, Japan, \*\*SHARP, 22-22 Nagaïke-cho,*

*Abe-no-ku, Osaka 545-8522, Japan, \*\*\*Division of Energy Engineering Science, Interdisciplinary Graduate School of Engineering Sciences, Kyushu, Japan*

**TEMPERATURE MEASUREMENT IN INTERNAL MICROSCALE FLOWS USING INFRARED THERMOGRAPHY**

V. Narayanan and V.A. Patil

*Oregon State University, Department of Mechanical Engineering, Corvallis, USA*

10:35 - 11:00 Coffee

11:00 - 12:20 **Session: FLOW BOILING 1 – FB1**

*Session chair: M.E. Poniewski*

**EXPERIMENTAL INVESTIGATION OF R-134A AND R-245FA TWO-PHASE FLOWS IN MICROCHANNELS FOR DIFFERENT FLOW CONDITIONS**

R. Revellin and J.R. Thome

*Heat and Mass Transfer Laboratory (LTCM), Ecole Polytechnique Fédérale de Lausanne (EPFL), Lausanne, Switzerland*

**AN EXPERIMENTAL STUDY OF FLOW BOILING OF WATER IN A MICROCHANNEL**

A. Pande, R. Kumar and A. Gupta

*Department of Mechanical and Industrial Engineering, Indian Institute of Technology Roorkee, Roorkee, India*

**MONDAY, SEPTEMBER 26, 2005 (continued)**

**EXPERIMENTAL INVESTIGATION OF TRANSIENT BOILING HEAT TRANSFER IN MICROCHANNELS**

M. Cortina Díaz and J. Schmidt  
*Institute of Fluid Dynamics and Thermodynamics, Otto-von-Guericke University  
Magdeburg, Germany*

**MASS FLOW OF AN ADVANCED TWO-PHASE THERMOSYPHON LOOP**

R. Khodabandeh, B. Palm and S. Kemper  
*Royal Institute of Technology, Dept. of Energy Technology, Div. of Applied  
Thermodynamics and Refrigeration, Stockholm, Sweden*

12:30 - 14:30

Lunch

14:30 - 15:15

**Keynote lecture: INTERFACE EFFECTS ON FLOW AND HEAT TRANSFER AT MICROSCALE**

X.G. Liang  
*Department of Engineering Mechanics, Tsinghua University, Beijing, China*  
Keynote chair: G.P. Celata

15:15 - 16:15

**Session: FLUID FLOW 1 – FF1**

Session chair: T. Ameel

**ANALYSIS OF PRESSURE AND VELOCITY DISTRIBUTIONS OF TURBULENT ASYMMETRIC FLOW IN A SYMMETRIC FLAT DUCT WITH SUDDEN EXPANSION**

Y. Salhi, M. Hammoudi, E.K. Si Ahmed, F. Aloui and M. Souhar  
*Laboratoire de Mécanique des Fluides Théorique et Appliqué e Faculté de Physique  
USTHB, Alger, Algeria*

**ON HYDRODYNAMIC PREDICTIONS OF NEAR-WALL EFFECTS IN RAREFIED GASES: SOME PHENOMENOLOGICAL AND MODELLING APPROACHES**

J.M. Reese\*, D.A. Lockerby\*\* and D.R. Emerson\*\*\*  
*\*Department of Mechanical Engineering, University of Strathclyde, Glasgow, UK,  
\*\*School of Engineering and Design, Brunel University, Uxbridge, UK \*\*\*Centre for  
Microfluidics and Microsystems Modelling, Daresbury Laboratory, Warrington, UK*

**GAS FLOW ANALYSIS THROUGH A BUNDLE OF MICROTUBES**

L. Marino  
*Department of Mechanics and Aeronautics, University of Rome 'La Sapienza', Italy*

16:15 - 16:45

Coffee

16:45 - 18:45

**Session: MICROFLUIDIC SYSTEMS 1 – MFS1**

Session chair: D. Poulikakos

**EFFECTIVE THERMAL CONDUCTIVITY OF LOTUS-TYPE POROUS COPPER WITH DIFFERENT SHAPE PORES**

T. Ogushi\*, H. Chiba \*, H. Nakajima\*\*, K. Torii\*\*\*, T. Tomimura\*\*\*\* and F. Ono\*\*\*\*\*  
*\*Advanced Technology R&D Center, Mitsubishi Electric Corporation, Amagasaki, Hyogo, \*\*The Institute of Scientific and Industrial Research, Osaka University, Ibaraki, \*\*\*Yokohama National University, \*\*\*\*Kyushu University, \*\*\*\*\*New Material Center, Japan*

**MONDAY, SEPTEMBER 26, 2005 (continued)**

**EXPERIMENTAL STUDY FOR AN ACOUSTIC RADIATION FORCE ACTING ON A SMALL PARTICLE IN A PROGRESSIVE WAVE**

S. Ebara\*, T. Asano\*\*, T. Yokomine\* and A. Shimizu\*

*\*Division of Energy Engineering and Science, \*\*Department of Advanced Energy Engineering Science, Interdisciplinary Graduate School of Engineering Sciences, Kyushu University, Japan*

**ENHANCED HEAT TRANSFER FOR POOL BOILING AT MICRO SCALE**

C.M. Rops\*, R. Lindken\*\*, J. Westerweel\*\* and J.F.M. Velthuis\*

*\*TNO Science & Industry, Delft, The Netherlands, \*\*Delft University of Technology, The Netherlands*

**THERMOPHORETIC SEPARATION IN MICROFLUIDICS**

P.F. Geelhoed and J. Westerweel

*Delft University of Technology, Laboratory for Aero and Hydrodynamics, The Netherlands*

**ON THE THREE DIMENSIONAL DIVERGENCE OF STREAMLINES FOR ISOTHERMAL PRESSURE DRIVEN FLOWS IN SMALL LENGTH SCALE FLUIDIC DEVICES**

P.A. Walsh, E.J. Walsh and M.R.D. Davies

*Stokes Research Institute, University of Limerick, Ireland*

**LIQUID PROPERTIES FOR DROPLET OR PLUG-FLOW MICROFLUIDIC POLYMERASE CHAIN REACTION DEVICES**

B. Barrett, N. SIRR, M. Sayers, T. Dalton and M. Davies

*Stokes Research Institute, Department of Mechanical & Aeronautical Engineering, University of Limerick Limerick, Ireland*

20:00

Dinner followed by Social Hour

**TUESDAY, SEPTEMBER 27, 2005**

07:30 – 08:30

Breakfast

08:30 - 09:15

**Keynote lecture: MICRO- AND NANOSCALE HEAT TRANSFER: FROM CARBON NANOTUBES TO FUEL CELLS**

D. Poulikakos

*Laboratory of Thermodynamics in Emerging Technologies, Institute of Energy Technology, Department of Mechanical and Process Engineering, ETH Zurich, Switzerland*

*Keynote chair: L. Tadrist*

09:15 – 10:15

**Session: FLUID FLOW 2 – FF2**

*Session chair: C. Nonino*

**USING VISCOUS HEATING TO DETERMINE THE FRICTION FACTOR IN MICROCHANNELS – AN EXPERIMENTAL VALIDATION**

G.P. Celata\*, G.L. Morini\*\*, V. Marconi\*, S.J. McPhail\* and G. Zummo\*

*\*ENEA, Institute of Thermal Fluid Dynamics, Rome, Italy, \*\*DIENCA, University of Bologna, Italy*

**LOCAL PRESSURE MEASUREMENT OF NITROGEN FLOWS IN AN ALUMINUM RECTANGULAR MICROCHANNEL**

D. Costaschuk, J. Elsnab, S. Petersen, J. Klewicki and T. Ameen

*Department of Mechanical Engineering, University of Utah, Salt Lake City, USA*

**EXPERIMENTAL STUDY ON COMPRESSIBILITY EFFECTS IN MICROTUBES**

G.P. Celata\*, M. Cumo\*\*, S.J. McPhail\*, L. Tesfagabir\* and G. Zummo\*

*\*ENEA, Institute of Thermal Fluid Dynamics, Rome, Italy, \*\*DINCE, University of Rome "La Sapienza", Italy*

10:15 - 10:35

**Session: HEAT EXCHANGERS – HEX**

*Session chair: J.R. Thome*

**CONCEPTS AND REALIZATION OF MICRO HEAT EXCHANGERS FOR ENHANCED HEAT TRANSFER**

J.J. Brandner, E. Anurjew, L. Bohn, E. Hansjosten, T. Henning, U. Schygulla, A. Wenka and K. Schubert

*Forschungszentrum Karlsruhe, Institute for Micro Process Engineering IMVT, Germany*

10:35 - 11:00

Coffee

11:00 - 12:20

**Session: HEAT EXCHANGERS – HEX (cont.)**

*Session chair: J.R. Thome*

**MICRO-STRUCTURED HEAT-EXCHANGERS AND INTEGRATED EVAPORATORS**

J. Schürer, V. Cominos, C. Hofmann, G. Kolb, D. Tiemann, Z.H. Wang, M. Wichert, V. Hessel and H. Löwe

*Institut für Mikrotechnik Mainz (IMM), Germany*

**NEW PRINTED CIRCUIT HEAT EXCHANGER WITH S-SHAPE FINS FOR HOT WATER SUPPLIER**

T.L. Ngo, Y. Kato, K. Nikitin and N. Tsuzuki

*Research Laboratory for Nuclear Reactors, Tokyo Institute of Technology, Japan*



**TUESDAY, SEPTEMBER 27, 2005** (continued)

**MODELLING COUNTER CURRENT MICRO HEAT EXCHANGERS**

T. Baier and K.S. Drese

*Institut für Mikrotechnik Mainz GmbH - IMM, Germany*

**HEAT TRANSFER AND FLUID FLOW IN A COUNTER FLOW MICRO HEAT EXCHANGER**

B.A. Nichita\*, F. Chiriac\* and D.G. Cacuci\*\*

*\*Technical University of Civil Engineering Bucharest, Romania, \*\*Technical University Karlsruhe, Germany*

12:30 - 14:30

Lunch

14:30 - 15:15

**Keynote lecture: REVIEW ON TWO-PHASE FLOW INSTABILITIES IN NARROW SPACES**

L. Tadrif

*IUSTI UMR CNRS, Marseille, France*

*Keynote chair: A. Jacobi*

15:15 - 16:35

**Session: MEASUREMENT TECHNIQUES 2 – MT2**

*Session chair: I. Catton*

**EFFECT OF MULTIPLE LASER IRRADIATIONS ON ABLATED HOLES**

Y. Yamashita\*, T. Yokomine\*\*, S. Ebara\*\* and A. Shimizu\*\*

*\*Department of Advanced Energy Engineering Science, \*\*Division of Energy Engineering Science, Interdisciplinary Graduate School of Engineering Sciences, Kyushu, Japan*

**AN EVALUATION OF PHASE MEASUREMENT INTERFEROMETRY OBTAINING FULL-FIELD TEMPERATURE MEASUREMENTS SCALE FLUIDIC JUNCTION**

P.A. Walsh, M.R.D. Davies and T. Dalton

*Stokes Research Institute, University of Limerick Plassey, Ireland*

**ULTRA FAST HEAT TRANSPORT ANALYSIS BY MODIFIED MD APPLYING NON-FOURIER LAW TO ELECTRON HEAT CONDUCTION**

Y. Yamashita\*, T. Yokomine\*\*, S. Ebara\*\* and A. Shimizu\*\*

*\*Department of Advanced Energy Engineering Science, \*\*Division of Energy Engineering Science, Interdisciplinary Graduate School of Engineering Sciences, Kyushu, Japan*

**DEVELOPMENT OF A MEASURING TECHNIQUE FOR THE LOCAL HEAT TRANSFER**

C. Klein and P. Ehrhard

*Forschungszentrum Karlsruhe GmbH., Institute for Nuclear and Energy Technologies, Germany*

16:35 - 17:00

Coffee

17:00 - 19:00

**Session: PHASE CHANGE – PC**

*Session chair: N. Kasagi*

**INERTIA-CONTROLLED REGIME OF COLLECTIVE BUBBLES GROWTH ON A FLAT MICROHEATER**

E.S. Vasserman and S.I. Lezhnin

*Institute of Thermophysics, Russian Academy of Sciences, Novosibirsk, Russia*

**TUESDAY, SEPTEMBER 27, 2005** (continued)

**MICROSCALE HEAT TRANSFER IN AN EVAPORATING MOVING EXTENDED MENISCUS**

S.S. Panchangam, J.L. Plawsky and P.C. Wayner, Jr.  
*Isermann Department of Chemical and Biological Engineering, Rensselaer Polytechnic Institute, Troy, NY, USA*

**BOILING ON BIPOROUS EVAPORATOR: EXPERIMENT AND MODELING**

A. Vadjal, I. Catton, T. Semenic and Y.Y. Lin  
*Mechanical and Aerospace Department - University of California Los Angeles, USA*

**MICROCHANNEL MEMBRANE SEPARATION APPLIED TO CONFINED THIN FILM DESORPTION**

J.D. Thorud, J.A. Liburdy and D.V. Pence  
*Department of Mechanical Engineering, Oregon State University, Corvallis, USA*

**TRANSIENT COOLING OF A VERY HOT THIN WIRE IMMERSSED INTO WATER**

G. Berthoud  
*CEA Grenoble, France*

**A THERMODYNAMIC APPROACH TO THE MODELLING OF EXPLOSIVE VAPORIZATION DEVELOPMENT ON A MICROHEATER**

E.S. Vasserman  
*Institute of Thermophysics, Russian Academy of Sciences, Novosibirsk, Russia*

20:00

Dinner followed by Social Hour

**WEDNESDAY, SEPTEMBER 28, 2005**

07:30 – 08:30

Breakfast

08:30 - 09:15

**Keynote lecture: MODELING HEAT TRANSFER AND PRESSURE DROP FOR LIQUID-VAPOR FLOWS IN THE ELONGATED-BUBBLE FLOW REGIME**

A. Jacobi

*Department of Mechanical and Industrial Engineering, University of Illinois at Urbana-Champaign, USA*

*Keynote chair: D. Poulikakos*

09:15 - 10:35

**Session: ADIABATIC TWO-PHASE FLOW – ATPF**

*Session chair: P.S. Hrnjak*

**FLOW PATTERNS AND PRESSURE DROP IN TWO PHASE FLOW MIXTURE OF NITROGEN AND WATER**

M. Fabbri\*, I. Catton\*\* and E. Merilo\*\*\*

*\*IBM Research GmbH - Zurich, CH, \*\*Mechanical and Aerospace Department - University of California Los Angeles, USA, \*\*\*SRI, Palo Alto, California, USA*

**EVALUATION OF RESIDENCE TIME DISTRIBUTION FOR BUBBLE TRAIN FLOW IN A SQUARE MINI-CHANNEL BY DIRECT NUMERICAL SIMULATION**

M. Wörner, B. Ghidersa and A. Onea

*Forschungszentrum Karlsruhe, IRS, Germany*

**NUMERICAL SIMULATION OF GAS-LIQUID TWO-PHASE CONVECTIVE HEAT TRANSFER IN A MICRO TUBE**

P. Ua-arayaporn\*, K. Fukagata\*, N. Kasagi\* and T. Himeno\*\*

*\*Department of Mechanical Engineering, \*\*Department of Aeronautics and Astronautics, The University of Tokyo, Japan*

**CFD SIMULATIONS OF THE EFFECT OF INLET CONDITIONS ON TAYLOR FLOW FORMATION**

N. Shao, W. Salman, A. Gavriilidis and P. Angeli

*Department of Chemical Engineering, University College London, UK*

10:35 - 11:00

Coffee Break

11:00 - 13:00

**Session: FLOW BOILING 2 – FB2**

*Session chair: L. Tadrist*

**INVESTIGATION OF CRITICAL HEAT FLUX IN SINGLE, UNIFORMLY HEATED MICROCHANNELS**

L. Wojtam, R. Revellin and J.R. Thome

*Heat and Mass Transfer Laboratory (LTCM), Ecole Polytechnique Fédérale de Lausanne (EPFL), Lausanne, Switzerland*

**FLOW BOILING VISUALIZATION IN A VERTICAL CIRCULAR MICROCHANNEL AT HIGH QUALITY**

W. Owhaib, C. Martin-Callizo and B. Palm

*Royal Institute of Technology (KTH), Department of Energy Technology, Stockholm, Sweden*

**AN EXPERIMENTAL INVESTIGATION OF FLOW BOILING IN AN ASYMMETRICALLY HEATED RECTANGULAR MICROCHANNEL**

C. Huh and M.H. Kim

*Department of Mechanical Engineering, POSTECH, Korea*

**WEDNESDAY, SEPTEMBER 28, 2005** (continued)

**COMPARISON OF AN EXTENDED DATABASE OF FLOW BOILING HEAT TRANSFER COEFFICIENTS IN MULTI-MICROCHANNEL ELEMENTS WITH THE THREE-ZONE MODEL**

B. Agostini and J.R. Thome

*Heat and Mass Transfer Laboratory (LTCM), Ecole Polytechnique Fédérale de Lausanne (EPFL), Lausanne, Switzerland*

**EQUALIZING CALCULUS IN MINICHANNEL FLOW BOILING HEAT TRANSFER CALCULATION**

S. Hozejowska, M. Piasecka and M.E. Poniewski

*Kielce University of Technology, Poland*

**EXPERIMENTAL STUDY OF VAPORIZATION IN A PARTIALLY HEATED SQUARE CROSS SECTION MINI CHANNEL: CAPILLARY DRIVEN AND FORCED CONVECTION FLOW CASES**

V. Serin, P. Soler, P. Lavieille and M. Miscevic

*Laboratoire d'Energétique, Université Paul Sabatier, Toulouse, France*

13:00 – 14:00

Lunch

13:00 – 18:00

Optional Excursion to Lucca (Box lunches for those on optional excursion)

14:00 - 20:30

Free time/ad hoc discussions

20:30

Banquet

**THURSDAY, SEPTEMBER 29, 2005**

07:30 – 08:30

Breakfast

08:30 - 09:15

**Keynote lecture: LOCALLY HEATED ANNULAR LIQUID FILMS IN MICROCHANNELS AND MINICHANNELS**

O. Kabov, Yu.V. Lyulin, I.V. Marchuk and D.V. Zaitsev

*Heat Transfer International Research Institute of Universite Libre de Bruxelles and Institute of Thermophysics of Russian Academy of Sciences, Brussels, Belgium*

*Session chair: J.R. Thome*

09:15 - 10:35

**Session: FLUID FLOW 3 – FF3**

*Session chair: A. Jacobi*

**PASSIVE MOVEMENT AND MANIPULATION OF MICROFLUIDS USING BUOYANCY**

E.J. Walsh, C.R. King, R.H. Grimes, M.R. Davies and T.M. Dalton

*Stokes Research Institute, Department of Mechanical and Aeronautical Engineering, University of Limerick, Ireland*

**COMPRESSIBILITY EFFECTS OF GAS FLOWS IN MICROTUBES**

G.L. Morini, M. Lorenzini and S. Salvigni

*DIENCA-Università di Bologna, Italy*

**THERMALLY DEVELOPING LAMINAR FLOW IN MICROCHANNELS WITH TEMPERATURE DEPENDENT VISCOSITY AND VISCOUS DISSIPATION**

S. Del Giudice, C. Nonino and S. Savino

*Dipartimento di Energetica e Macchine, Università degli Studi di Udine, Italy*

**EFFECTS OF VISCOUS DISSIPATION AND TEMPERATURE DEPENDENT VISCOSITY IN SIMULTANEOUSLY DEVELOPING LAMINAR FLOW IN MICROCHANNELS**

C. Nonino, S. Del Giudice and S. Savino

*Dipartimento di Energetica e Macchine, Università degli Studi di Udine, Italy*

10:35 - 11:00

Coffee

11:00 - 12:20

**Session: SINGLE-PHASE HEAT TRANSFER – SPHT**

*Session chair: X.G. Liang*

**JET IMPINGEMENT COOLING IN MICROSCALE**

C. Glynn and D.B. Murray

*CTVR (Centre for Telecommunications Value-Chain-Driven Research), Department of Mechanical and Manufacturing Engineering, Trinity College, Dublin, Ireland*

**THREE-DIMENSIONAL ROUGHNESS EFFECT ON MICROCHANNEL HEAT TRANSFER AND PRESSURE DROP**

G. Croce, P. D'Agaro, C. Nonino and F. Zani

*Dipartimento di Energetica e Macchine, Università degli Studi di Udine, Italy*

**OPTIMIZATION OF SINGLE PHASE MICROSCALE FRACTAL-LIKE BRANCHING FLOW HEAT SINKS**

K.E. Enfield, D.V. Pence and V. Narayanan

*Oregon State University, Mechanical Engineering Department, Corvallis, USA*

**THURSDAY, SEPTEMBER 29, 2005 (continued)**

**MICROTUBE HEAT TRANSFER SCALING EFFECTS – AN EXPERIMENTAL VALIDATION**

G.P. Celata\*, M. Cumo\*\*, V. Marconi\*, S.J. McPhail\* and G. Zummo\*  
*\*ENEA, Institute of Thermal Fluid Dynamics, Rome, Italy, \*\*DINCE, University of Rome 'La Sapienza', Italy*

12:30 - 14:30

Lunch

14:30 - 16:30

Session: **MEMS SYSTEMS AND MICROFLUIDIC DEVICES 1 – MSMD1**  
*Session chair: D. Pence*

**DYNAMIC AND THERMAL MICRO-BOILING CHARACTERIZATION**

S. Escobar-Vargas\*, D. Fabris\*, J.E. Gonzalez\*, R. Sharma\*\*, C. Bash\*\*, L. Ortiz\*\*\* and J. Cartagena\*\*\*  
*\*Santa Clara University, Department of Mechanical Engineering, CA, USA, \*\*Hewlett Packard Laboratories, Palo Alto, CA, USA, \*\*\*Hewlett Packard of Puerto Rico, Agüadilla, PR*

**FEASIBILITY OF MICRO HEATING IN THE FOOD INDUSTRY**

M. Verschueren, P. de Jong and J.J. van Haren  
*Department of Processing, NIZO food research, Ede, The Netherlands*

**EXPLOSIVE VAPORIZATION IN MICROENCLOSURES**

G. Romera-Guereca\*, J. Lichtenberg\*\*, A. Hierlemann\*\* and D. Poulikakos\*  
*\*Laboratory of Thermodynamics in Emerging Technologies, \*\*Physical Electronics Laboratory, Swiss Federal Institute of Technology Zurich, Switzerland*

**INTEGRATED MICRO-THERMOELECTRIC COOLER FOR MICROFLUIDIC CHANNELS**

G. Rosengarten, S. Mutzenich and K. Kalantar-zadeh  
*School of Electrical and Computer Engineering, RMIT University, VIC, Australia*

**CHANNEL NETWORKS FOR OPTIMAL HEAT TRANSFER AND HIGH THROUGHPUT MIXERS**

N. Kockmann, T. Kiefer, M. Engler and P. Woias  
*Laboratory for Design of Microsystems, Institute of Microsystem Technology, IMTEK, Albert-Ludwig University of Freiburg, Germany*

**SPECTRAL APPROACH TO CHAOTIC MIXING IN MICROFLOW DEVICES**

S. Cerbelli\*, F. Creta\*\*, A. Adrover\*, M. Valorani\*\* and M. Giona\*  
*\*Dip. Ingegneria Chimica, \*\*Dip. Meccanica ed Aeronautica, Università di Roma 'La Sapienza', Italy*

16:30 - 17:00

Coffee

**THURSDAY, SEPTEMBER 29, 2005 (continued)**

17:00 - 18:00

**Session: MICROFLUIDIC SYSTEMS 2 – MFS2**

*Session chair: J. Brandner*

**A FULLY CONTROLLED NATURAL CONVECTION POLYMERASE CHAIN REACTION DEVICE**

J. Daly, M. Davies and T. Dalton

*Stokes Research Institute, Department of Mechanical and Aeronautical Engineering, University of Limerick, Ireland*

**MICRO-SCALE DROPLET CONTROL AND COALESCENCE ON HETEROGENEOUS SUBSTRATES**

H.M. Thompson, N. Kapur, Y-C Lee, N. Teo and P.H. Gaskell

*Engineering Fluid Mechanics Research Group, School of Mechanical Engineering, University of Leeds, UK*

**A NUMERICAL STUDY ON THE FREEZE DRYING OF SPRAYED PARTICLE PACKING**

C.S. Song\* and J.H. Nam\*\*

*\*Korea Institute of Machinery and Materials, Daejeon, Korea, \*\*Ilshin Lab Co., Gyeonggi-do, Korea*

18:00 - 19:00

**Session: CONDENSATION – CON**

*Session chair: O. Kabov*

**FORCED CONVECTION CONDENSATION INSIDE MINICHANNELS: GUIDELINES FOR A NEW PREDICTIVE PROCEDURE**

A. Cavallini, D. Del Col, L. Doretto, M. Matkovic, L. Rossetto and. C. Zilio

*Dipartimento di Fisica Tecnica, Università di Padova, Italy*

**HEAT TRANSFER ANALYSIS ACCORDING TO CONDENSATION FLOW STRUCTURE IN A MINICHANNEL**

B. Médéric, L. Pascal and M. Miscevic

*Laboratoire d'Energetique, Université Paul Sabatier, Toulouse, France*

**MOLECULAR GAS DYNAMICS APPROACHES TO INTERFACIAL PHENOMENA ACCOMPANIED WITH CONDENSATION**

S. Mikami, T. Ota, K. Kobayashi, S. Fujikawa, T. Yano and M. Ichijo

*Division of Mechanical and Space Engineering, Graduate School of Engineering, Hokkaido University, Sapporo, Japan*

20:00

Dinner followed by Social Hour

**FRIDAY, September 30, 2005**

07:30 – 08:30 Breakfast

08:30 - 09:15 Keynote lecture: **SINGLE-PHASE PRESSURE DROP IN MICROCHANNELS**  
P.S. Hrnjak\* and X. Tu\*\*  
*\*Department of Mechanical and Industrial Engineering, University of Illinois at Urbana-Champaign, USA, Microsoft Corp., USA*  
Keynote chair: G. Zummo

09:15 - 10:35 Session: **FLUID FLOW 4 – FF4**  
Session chair: G. Zummo

**SLIP EFFECT IN MICROCHANNEL FLOW**

A. Yamamoto\*, S. Mori\*\*, K. Katori\*, D. Tsuboi\*\* and M. Suzuki\*\*  
*\*Tokyo Institute of Technology Intensive Center, The Research Association of Micro Chemical Process Technology, Department of Chemical Engineering, Tokyo Institute of Technology, \*\*Department of Chemical Engineering, Tokyo Institute of Technology, Japan*

**FLOW PATTERNS IN EVAPORATING MINI-LAYERS WITH AN INERT GAS FLOW**

C.S. Iorio\*, O. Kabov\*\*\* and P. Colinet\*  
*\*Universite Libre de Bruxelles, Microgravity Research Center, Brussels, Belgium, \*\*Heat Transfer International Research Institute of Universite Libre de Bruxelles and Institute of Thermophysics of Russian Academy of Sciences, Brussels, Belgium*

**STUDIES ON MICRO NOZZLE FLOWS FOR MICRO SPACECRAFT PROPULSION**

V.R. Sanal Kumar\*, H.D. Kim\*, B.N. Raghunandan\*\*, T. Setoguchi\*\* and S. Raghunathan\*\*\*\*  
*\*Andong National University, Korea, \*\*IISc, India, \*\*\*Saga University, Japan, \*\*\*\*Queen's University Belfast, UK*

**ENERGY AND MOMENTUM TRANSFER IN AN ULTRA-THIN LIQUID WATER FILM SHEARED BETWEEN SOLID SURFACES**

D. Torii and T. Ohara  
*Graduate School of Engineering, Tohoku University, Japan*

10:35 - 11:00 Coffee

11:00 - 12:20 Session: **MEMS SYSTEMS AND MICROFLUIDIC DEVICES 2 – MSMD2**  
Session chair: J.A. Liburdy

**NUMERICAL INVESTIGATION ON CARRIER-PHONON INTERACTIONS IN GAAS THIN FILM STRUCTURES IRRADIATED BY PICOSECOND LASER PULSES**

J.H. Lee and S.H. Lee  
*School of Mechanical Engineering, Chung-Ang University, Seoul, Korea*

**THERMAL CHARACTERISTICS OF THE HIGH HEAT FLUX MICRO EVAPORATOR**

T. Tsukamoto and R. Imai  
*Ishikawajima-Harima Heavy Industries Co., Ltd., Yokohama, Japan*



**FRIDAY, SEPTEMBER 30, 2005** (continued)

**MICRO HEAT SPREADERS FOR CONCENTRATED POWER FLUXES ON SPACECRAFTS: FIRST ASSESSMENT**

R. Rebolo\*, J. Ausín\*, P. Alvarez\* and J. Steelant\*\*

\**SENER, Ingeniería y Sistemas, S.A., Spain*, \*\**ESTEC – ESA, The Netherlands*

**PATH FLOW MINIATURIZATION AND IRREVERSIBILITY**

G. Dumitrascu\* and M. Sasso\*\*

\*\**Gh. Asachi" Technical University of Iasi, Engineering Thermodynamics Department, Romania*, \*\* *Università degli Studi del Sannio, DING, Benevento, Italy*

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|---------------|---|
| 12:20 - 12:45 | Summary and future plans                      |
| 12:45 – 14:00 | Lunch   |
| 14:00         | Bus departs to Pisa train station and airport |