The 35th International Symposium on Microelectronics

imaps 2002

Mine Denver

September 4-6, 2002
Colorado Convention Center
Denver, Colorado

Organized by the:
IMAPS 2002 Symposium Committee
and the Rocky Mountain Chapter

Sponsored by:
The International Microelectronics And Packaging Society (IMAPS)

1

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imaps 2002

Symposium Committee – Denver

General Chair
James R. Drehle, Agilent
jim_drehle@agilent.com

Technical Chair
Rick Charbonneau, StorageTek
CharbRA@LOUISVILLE.STORTEK.COM

PDC Chair
Bin Zou, NanoPierce Technologies, Inc.
bin.zou@nanopierce.com

Arrangements Chair
Eric D. Underwood, JLR The Engineering Solutions Co.
eunderwood@jlrcom.com

Exhibits Co-Chair
Warner B. Andrews, Rep of the Rockies
warner@andrews394.com

Exhibits Co-Chair
Andy Cornedi, Rep Sales
repsales@worldnet.att.net

Foundation Auction Chair-National
Gary Hemphill, Technic, Inc.
gph@technic-epe.com

President/Foundation Golf Chair-Local
Charles E. Bauer, TechLead Corporation
Chuck.Bauer@TechLeadCorp.com

Foundation Golf Chair-National
John H. Wood, Emerson & Cuming
john.wood@nstarch.com

Employment Center Chair
Susan M. Munyon
SusanMunyon@attbi.com

Marketing Forum Chair
Michael P. O'Neill, Heraeus Incorporated-Circuit Materials Division
moneill@4cmd.com

Publicity Chair-General Technologies
John L. Leicht
leichtjohn@qwest.net

Publicity Chair-Industry Focused
Courtland Robinson, Robinson Technical Consulting
cnrconsulting@worldnet.att.net

Registration Chair
David E. Koehler, Alphatek, Inc.
dkoehler@alphatek-inc.com

Secretary
Mitchy Lenihan
NMLenihan@aol.com

Sponsorship Chair
Paul M. Anderson, Dimensional Circuits Corporation
pandersn@peakpeak.com

Spouse/Guest Program Chair
Katherine Bauer
katherine.bauer@attglobal.net

Student Program Chair
Jim Leonard
jleonard@carbon.cudenver.edu

1st Past President
Greg Caswell, XeTel Corporation
gcaswell@xetel.com

2003 General Chair
Delip R. Bokil, NAMARK Associates
d.bokil@ieee.org

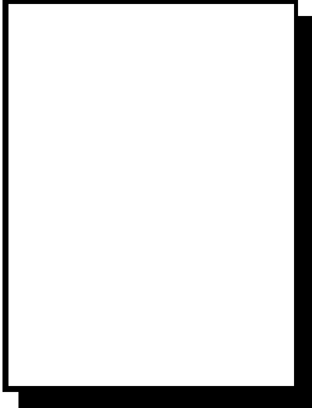
IMAPS Executive Director
Richard Breck, IMAPS
rb1959@aol.com

Symposium Committee Picture Here!

Top Row (Left to Right): David Koehler, Courtland Robinson, Jim Leonard, Katherine Bauer, Rick Charbonneau and Warner Andrews
Bottom Row (Left to Right): Bin Zou, Eric Underwood, Jim Drehle and Andy Cornedi

greetings

From the General Chair



The Denver 2002 Symposium Committee welcomes you to the **Microelectronics Gold Rush** at the 35th International Symposium on Microelectronics. The IMAPS 2002 Steering Committee and the Rocky Mountain Chapter members are proud to share with you the beauty and grandeur of Colorado, an IMAPS Technical program that exceeds your expectations and an Exhibition highlighting the latest in Materials and Equipment. We hope that you spent the Labor Day weekend in Colorado. If not, take some time after the show to enjoy some of the beauty and grandeur of the Colorado Rocky Mountains. You can hike, bike, fish, play urban cowboy at a dude ranch, attend a Colorado Rookies Baseball game or enjoy Colorado's many Narrow Gage Train Adventures. Bring the family out and enjoy Colorado. I recommend you spend as much time enjoying Colorado as you can spare.

We are all fortunate to work in a technology area that drives a significant and increasing portion of the industrial world's economy. The Denver Symposium is designed to maximize your opportunity to gain knowledge in many areas of advanced microelectronics packaging and system technologies. We encourage you to **Mine Denver 2002** Technical Program and Exhibition. The Professional Development Courses offer many of the excellent courses that IMAPS presented in the past years and we have broadened the program with several New Courses. Courses will be held on Tuesday and Friday. These courses cover a broad spectrum of microelectronics packaging and system technologies. The Technical Program contains 22 Technical Sessions, Marketing Forum and Poster Session. This is your opportunity to talk to the experts about your individual concerns and problems. I encourage you to bug those authors with questions after their presentations. The Leading Manufacturers will be displaying the latest in Materials and Manufacturing Equipment at the Exhibition. Visit them and see the material and equipment solutions you need now. Challenge the exhibitors with your future requirements.

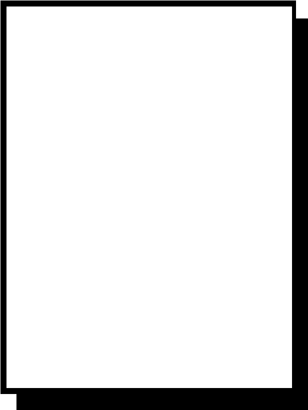
Take the time to dialog with your colleagues from around the world who are working with these technologies in many industries. Professionals from Automotive, Optoelectronics, High Frequency, Microwave, Medical, Security and many more industries are here. The Welcome Reception provides a pleasant location where you can meet old friends, and talk with colleagues from around the world in an atmosphere conducive to relaxation and conversation. Learn about leading edge advancements, new materials and process improvements they are using to solve current problems, and to provide solutions for many new challenges. Discover the latest in Process Control, new materials and leading edge Manufacturing techniques to realize those new challenges. **Mine Denver 2002 Technical Program and Exhibition** for the solutions you need for future products.

The **Awards Ceremony** honors many of the IMAPS members and IMAPS Corporate Members who contributed so much to the Society over many years. We **encourage you** to attend this special recognition ceremony. We owe many of these Individuals and Companies a great deal of thanks for their contributions to the Microelectronics Packaging and System Industries. This is our chance as a Society and you as an individual to say **"Thanks."**

Review this brochure carefully for your areas of interest; we know you will be busy. Learn more about the Technical Sessions, Professional Development Courses, Committee Meetings and Special Events, just turn the pages. This Final Program contains a wealth of information that covers all of the events to be held during the **Microelectronics Gold Rush.** Take advantage of the Sidney J. Stein Educational Foundation Golf Tournament and Silent Auction and the Spouse/Guest Program. **Thank you** for joining the Drehle Desperadoes at the **Microelectronics Gold Rush** and **Mine Denver 2002.**

James R. Drehle

Agilent
jim_drehle@agilent.com
IMAPS 2002 General Chair



It is my pleasure to welcome you to Denver, Colorado for the 35th International Symposium on Microelectronics. IMAPS 2002 not only brings you 17 professional development courses taught by leading industry professionals, but will also present 120 original papers from all over the world. In addition, there will be 30 interactive poster presentations for you to see and meet the presenters.

Year after year, IMAPS delivers unmatched quality of papers and presentations on new and emerging technologies. This year's conference has a strong line-up of papers focusing on the more well-established topics such as hybrid microelectronics and surface mount technology, but also presentations focusing on the new and emerging topics such as: lead-free soldering, precision opto-electronic assembly and packaging, the state-of-the-art in MEMS technologies, wireless applications, high density interconnection, integrated passives and much more.

Thanks for joining us in the mile high city. We've got a gold mine of information for you to discover. Along with the exceptional technical program, please take advantage of the networking opportunities and spend some quality time with your peers.

Enjoy your stay in Denver!

Richard Charbonneau

StorageTek
CharbRA@LOUISVILLE.STORTEK.COM
IMAPS 2002 Technical Chair

message
From the President

WELCOME TO IMAPS 2002

Welcome to Denver and the Rocky Mountains! Jim Drehle, Rick Charbonneau and the entire 2002 Symposium Committee tirelessly assembled one of the strongest technical programs in several years by selecting a mere 40% of the abstracts submitted for actual presentation at the symposium!

I am proud to be one of the few IMAPS Presidents to see the International Microelectronics Symposium and Exhibition held in the city where I live. Denver displays many of the best attractions of the American West; beautiful blue skies, an awesome skyline dominated by the Rocky Mountains, and the most incredible (and changeable!) weather in the world. While in Denver see where your money comes from (the Denver mint), the home of the "Unsinkable Molly Brown" (one of the few survivors of the Titanic) and the arenas of Colorado's professional sports teams, the Denver Broncos (Mile High Stadium), Colorado Avalanche (The Can!) and Colorado Rockies. Baseball's Rockies even play the weekend following the symposium, so stick around and catch a game at Coors Field!

The surrounding area offers the Garden of the Gods, the Pro Rodeo Hall of Fame, NORAD and Pikes Peak to the south in Colorado Springs. And University of Colorado, Boulder, Rocky Mountain National Park and Long's peak to the north in Boulder and Estes Park. The Great Plains to the east and world famous ski resorts Vail and Aspen to the west, both beautiful in summer as well. Don't forget to try some buffalo prime rib, elk medallions, pheasant, rattle snake or Rocky Mountain oysters at one of the local restaurants to pick up a flavor of our local cuisine.

With special attractions at the symposium in the areas of automotive electronics and MEMS along with new and innovative materials, processes, equipment and technologies available for your product creations, the IMAPS National Symposium in Denver should prove one of the best yet! Mine Denver for the solutions you need and relax a little afterwards.

Thars GOLD in them thar hills! And Ag, Pt, Pd, Ni, Ru, Cu, Mo, W, In, Pb, Sn, Ti, Nb, ... as well!!!!

Charles E. Bauer

President, IMAPS

committee meetings and special events

Tuesday, September 3		
Foundation Golf Tournament	6:45 a.m. - 4 p.m.	Adam's Mark Hotel: Lobby
PDC Reception	5 p.m. - 6 p.m.	CCC: A207
Welcome Reception	6:30 p.m. - 8 p.m.	Adam's Mark Hotel: Plaza Ballroom
Wednesday, September 4		
MMRC Steering Cmte.	7 a.m. - 8 a.m.	CCC: A102
Student Booth Judging	9 a.m. - 11 a.m.	CCC: Exhibit Hall A
Awards Ceremony	11:40 a.m. - 12:15 p.m.	CCC: Exhibit Hall A
Lunch in the Exhibit Hall (All Attendees)	12:15 p.m. - 2:30 p.m.	CCC: Exhibit Hall A
Annual Business Meeting	1:45 p.m. - 2 p.m.	CCC: Exhibit Hall A
Press Conference	2:30 p.m. - 3:15 p.m.	CCC: A103
Student Panel Discussion	3 p.m. - 4:30 p.m.	CCC: A112
Student/Industry Reception	4:30 p.m. - 5:30 p.m.	CCC: A112
Thursday, September 5		
CII	7 a.m. - 8:30 a.m.	CCC: A102
Student Plant Tour	8 a.m. - 11:30 a.m.	Adam's Mark Hotel: Lobby
Chapter Leadership & Student Chapter Advisors	9 a.m. - 10 a.m.	CCC: A101
Foundation Trustees	10 a.m. - Noon	CCC: A102
International Leadership	10 a.m. - Noon	CCC: A104
Friday, September 6		
2003 Symposium Committee Meeting	9:30 a.m. - 10:30 a.m.	CCC: A101
Exhibitor Wrap-up	10:30 a.m. - 11:30 a.m.	CCC: A112
Technical Committee Luncheon *(Invitation Only)*	Noon - 1:30 p.m.	CCC: A103

Welcome Reception

Tuesday, September 3

at the

Adams Mark Hotel

6:30 PM – 8:00 PM

Plaza Ballroom

Please join us for the **Microelectronics Gold Rush Welcome Reception** as you prepare to **Mine Denver 2002** and experience all the latest developments in Microelectronics and Packaging. Enjoy an evening of excellent food and refreshments, meet friends and colleagues, make new acquaintances, and carry on quiet conversations. If you prefer to limber up your joints before heading off on your gold mining adventure, you are welcome to join in with the Stanleytones as they strum and pick bluegrass music throughout the evening. Whatever your preference, we look forward to seeing you and hope to get you started along a rewarding path to your own gold mine.

May the **paymaster** visit you often during your visit to Denver!

Eric D. Underwood
JLR The Engineering Solutions Co.
eunderwood@jlrcom.com
IMAPS 2002 Arrangements Chair

general information

IMAPS Show Management

Tuesday - Friday		CCC: A109
(703) 919-5716		

Press Room

Wed. & Thurs.	8 a.m. – 5 p.m.	CCC: A103
Friday	8 a.m. – Noon	CCC: A103

Speaker Ready Room

Tuesday	8 a.m. – 4 p.m.	CCC: A212
Wed. & Thurs.	7 a.m. – 5 p.m.	CCC: A212
Friday	7 a.m. – Noon	CCC: A212

Speaker Breakfast

Wed. - Friday	7 a.m. – 8 a.m.	CCC: A214

Registration

Tuesday	8 a.m. – 4 p.m.	CCC: Lobby A
Wednesday	7 a.m. – 6 p.m.	CCC: Lobby A
Thursday	7 a.m. – 5 p.m.	CCC: Lobby A
Friday	7 a.m. – Noon	CCC: Lobby A
Friday (PDC)	**11 a.m. – 6 p.m.**	**Adam's Mark Hotel**

Exhibit Hours

Wednesday	9 a.m. – 6 p.m.	Exhibit Hall A
Thursday	9 a.m. – 5 p.m.	Exhibit Hall A
Friday	9 a.m. – Noon	Exhibit Hall A

Exhibitor Lounge

Wed. - Friday	ALL DAY	Exhibit Hall A

Proceedings Pick-up

Pick-up your Symposium Proceedings (Book & CD-ROM) at the IMAPS Membership Booth.

Refreshments & Lunch Break

Wednesday through Friday all refreshment breaks will be located at *Café IMAPS* in Exhibit Hall A. **A buffet lunch will be served on Wednesday in Exhibit Hall A for all attendees.**

Spouse/Guest Program

Wednesday, September 4 and Thursday, September 5, *Spouse/Guest Tours will depart from the Adam's Mark Hotel.* **On Wednesday the bus departs at 10 a.m**. and returns at approximately 4 p.m. **On Thursday the bus departs at 9 a.m**. and returns at approximately 5 p.m.

Foundation Golf Classic

Tuesday, September 3rd.
Arrowhead Golf Club - Littleton, CO.
Bus departs Adam's Mark Hotel front entrance at 6:45 a.m.

IMAPS Annual Business Meeting

Wednesday, September 4
1:45 pm - 2 pm
Colorado Convention Center
Exhibit Hall A

Change of Officers
Presidents' Messages to the Membership
Annual Business Meeting

MEMS ATW

Packaging of MEMS and Related Micro Integrated Nano Systems

September 6-8, 2002
Adam's Mark Hotel
Registration Opens at 11 AM

Chairs:
Ajay P. Malshe & William D. Brown, University of Arkansas

IMAPS Refreshment Breaks

sponsored by:

AMI/Presco
Chip Supply, Inc.
Seagate Technology

IMAPS 2002 Corporate Sponsors

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Internet Cafe
ANSYS, Inc.
Hewlett-Packard

Logo Bags
MRSI

Badge Holder Lanyards
SEFAR America/MEC Division

Bus Sponsor
Agilent Technologies, Inc.

Exhibit Hall Luncheon
Laserage Technology Corp.

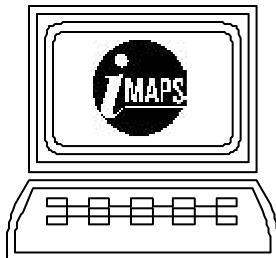
International Reception
NanoPierce Technologies, Inc.

President's Party
Amitron/Anaren Microwave
Hereaus Incorporated - CMD

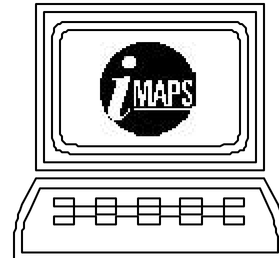
Exciting New Feature...

IMAPS 2002 will inaugurate the first

"IMAPS Internet Cafés"



Visit them both and
get on-line with IMAPS!



featuring:

- 6 PC stations with high-speed Internet connections, so you can surf the web or check your e-mail within seconds.
- 2 convenient locations to better serve you.

Registration Area Internet Café sponsored by
ANSYS, Inc.

Exhibit Hall Internet Café sponsored by
Hewlett-Packard

Raffle and Auction

to benefit the
Sidney J. Stein Educational Foundation

New this year at IMAPS 2002 will be a Raffle at the Welcome Reception. Attendees may buy tickets for $1 and place them in a basket in front of the item they wish to take a chance on. A drawing will be held for each item and the person with the corresponding numbered ticket will take that item home. Items in the Raffle will have a top value of $50. A "live" Auction will take place at the Symposium and will feature items with a value in excess of $50 with the item going to the highest bidder.

Auction Donations as of July 26:

Steve Capp, Laserage Technology Corp.
Item: (1) Visioneer One Touch 8100 Scanner
Value: $100.00

Peter Sexton, Metalor Technologies
Weekend or 5 day week, 2 br/2bath condo May - Oct., Killington, VT

Art Dobie, Sefar America - MEC Division
DVD player, gift cards Home Depot, Blockbuster, etc.

Art Dobie, As an individual member, Fellow of the Society, IMAPS
Walkman-type CD player

Maris Listello, Reed Business
EP&P canvas organizer attache case

Donna Schupack, Gannon & Scott
Gift certificate for 2 - 2 lb lobsters

Roger Underwood, CCT Laser Services
2 bottles of Dom Perignon champagne
Estimated value: $125.00 per bottle

Joe McCabe, Epoxy Technology
Dinner for two

Robert Slack, Gerb Refining Corp.
Gold coin pendant on a 14KT chain

Cynthia Rapina, Sabin Metal
2 dozen golf balls

Gary Hemphill, Technic Inc.
2 bottles of wine

James R. Drehle, Agilent
2 bottles of wine

Golf Hole Sponsors

AMI/Presco
Accu-Tech Laser Processing, Inc.
Chip Supply, Inc.
Coorstek
DuPont Microcircuit Materials
Emerson and Cuming/National Starch & Chemical
Metalor Technologies USA
Metech, Inc./Lord Corp.
Midas Vision Systems, Inc.
Presidio Components, Inc.
Shoei Electronic Materials Inc.
Technic, Inc.

2002 IMAPS AWARDS CEREMONY

Wednesday, September 4
11:40 AM - 12:15 PM
Colorado Convention Center
Exhibit Hall A

I would like to extend a welcome to all of you to attend this year's **IMAPS Awards Ceremony**. Each year IMAPS goes through a rigorous selection process to identify those members of the Society who have exhibited extraordinary support of IMAPS through technical and societal activities. We will award the **Daniel C. Hughes, Jr., Memorial Award** (highest award the Society presents to an individual), the **Corporate Recognition Award**, the **William Ashman Memorial Award**, the **John A. Wagnon Technical Achievement Award**, and **Fellow of the Society**. This year IMAPS added a brand new **International Award** for an individual who has provided significant international technical and/or leadership contributions to the electronics packaging industry, while participating and demonstrating support of IMAPS International activities.

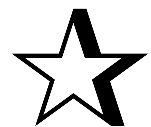
The Society will also recognize the best **Paper of the Symposium (IMAPS 2001)** and **Best Paper of Conference (International Conference on Advanced Packaging and Systems)**.

This is **your opportunity to thank** not only these individuals and companies but to thank the 2002 Symposium Committee, and all of the companies that have supported IMAPS 2002 as sponsors.

The ceremony will take place in Exhibit Hall A. Lunch will be served in the Exhibit Hall right after the ceremony. Please come join us in recognizing the achievements of the award winners as their dedication is an integral part of the IMAPS success story.

Greg Caswell
XeTel
IMAPS 1st Past President

1st Place



IMAPS Executive Council
and the
IMAPS 2002 Denver Symposium Committee
Congratulates
all
Award Winners!

Daniel C. Hughes, Jr. Memorial Award

presented to

Rao R. Tummala, Ph.D.

For Significant Technical Contributions to IMAPS in the fields of Materials and Processes for Advanced Ceramic Packaging, Flip Chip Technology and Integrated Passives; commitment to the development of students in the industry; and commitment to the Society in the capacity of President, Technical Vice President, and International Vice President, advancing both the Technical Scope and the Membership Programs of the Society.

John A. Wagnon Technical Achievement Award

presented to

Theodore G. Tessier, Ph.D.

For advancing the state-of-the-art in Chip Scale Packaging, Wafer Level CSP and High Density Interconnect.

William D. Ashman Memorial Award

presented to

Leonard W. Schaper, Ph.D.

For outstanding contributions to the field of Electronic Packaging, particularly advances in board, module, and chip package power distribution and decoupling capacitor design, leading to higher performance system designs.

Fellow of the Society

presented to

Kaoru Hashimoto

Herbert Neuhaus, Ph.D.

Stanislaw Nowak

For significant and continuing contributions to IMAPS over the course of many years.

Corporate Recognition Award

presented to

Semi Dice, Inc.

In appreciation of dedicated service and in recognition of outstanding contributions to the advancement and success of IMAPS through continued financial support of the Sidney J. Stein Educational Foundation; corporate involvement with the MMRC and involvement with the Known-Good-Die issue that has advanced awareness of Flip Chip Technology in the microelectronics industry.

International Award

presented to

Hans O. Danielsson, Ph.D.

In recognition of long-term continuing technical and organizational work significantly contributing to the International growth of the Society.

IMAPS 2001 Best Paper Awards

Best Paper of the Symposium

WP2: Integrated Passive Technology with PWB & Thin Film Processing for RF and High Speed Applications (R. Heistand & T. Lenihan)
Thin Film Capacitors Embedded into High Density Printed Circuit Boards
Angus I. Kingon, Taeyun Kim, Paula Vilarinho, Jon-Paul Maria, North Carolina State University; Robert T. Croswell, Motorola Advanced Technology Center

Outstanding Papers

TP1: Recent Development in Wafer Level Chip Scale Packages (M. Gerber & M. Toepper)
On-Wafer Process for Stress-Free Area Array Floating Pads
Raymond A. Fillion, Robert J. Wojnarowski, Herbert Cole, Glenn Claydon, GE Corporate R&D

WP3: Cu Wirebond and Reliability (M. Sheaffer & R. Keusseyan)
Wire Bonding to Advanced Copper-Low-K Integrated Circuits, the Metal/Dielectric Stacks and Materials Considerations
George G. Harman, Christian E. Johnson, NIST

Best of Session

TA1:MEMS in Aerospace and Aeronautics Applications (J. Champion)
Micro-Scale Avionics Thermal Management
Matthew E. Moran NASA Glenn Research Center

TA2: Next Generation Manufacturing Technology (N. Cavanah & T. Baum)
Zero Shrink Process for Cost Sensitive High Volume LTCC Applications
Mike F. Barker, Rick Draudt, DuPont Microcircuit Materials

TA3: Microfabrication (J. Jayaraj)
Large Suspended Bond-wire High Q Solenoid-type Inductors and $SrTiO_3$ Thin Film Capacitors for Wireless Applications
Jae Y. Park, Yun S. Eo, Jong U. Bu, LG Electronics Institute of Technology; Kye I. Jeon, RF Core Co. Ltd.

TA4: HD Organic Board Technologies (R. W. Johnson)
High Density Wiring Substrate with Molded Polymer-Core Bumps for Flip Chip CSP
Midori Kobayashi, Yasukazu Kishimoto, Toshiba Chemical Corporation; Kazuhito Higuchi, Susumu Kimijima, Toshiba Corporation

TP1: Recent Development in Wafer Level Chip Scale Packages (M. Gerber & M. Toepper)
On-Wafer Process for Stress-Free Area Array Floating Pads
Raymond A. Fillion, Robert J. Wojnarowski, Herbert Cole, Glenn Claydon, GE Corporate R&D

TP2: Wideband Materials Characterization for RF, Microwaves, and Wireless (M. Stein & P. Barnwell)
High Dielectric Constant Materials Development for LTCC
Mike Lanagan, Dean Anderson, Amanda Baker, Juan Nino, Steve Perini, Clive Randall, Tom Shrout, Hiro Sogabe, Hyuk-Joon Youn, The Pennsylvania State University

TP3: Materials (H. Neuhaus & S. Bagen)
Screen-Printed $Pb(Zr, Ti)O_3$ Thick Films for Ultrasonic Medical Imaging Applications
Marija Kosec, Janez Holc, Josef Stefan Institute; Franck Levassort, Louis Pascal Tran-Huu-Hue, Marc Lethiecq, LUSSI/GIP Ultrasons

TP4: Thermal Management (A. P. Malshe & T. Railkar)
Failure Mechanisms in High Power Optical Device Packaging: Semiconductor Laser Diodes – A Case Study
Ajit R. Dhamdhere, Ajay P. Malshe, S. N. Yedave, W. F. Schmidt, W. D. Brown, University of Arkansas; John Morales, Coherent Semiconductor Inc.

TP5: High Density Packaging (R. Chanchani & S. Popelar)
A Multi-Layer Thin-Film MCM-D QPSK Modulator for VSAT Applications
G. Carchon, K. Vaesen, S. Brebels, W. De Raedt, E. Beyne, IMEC; P. Van Loock, Alcatel Bell Space; B. Nauwelaers, K.U. Leuven

WA1: High Density Packaging for Portable Terminal Equipment in Japan (Y. Shimada & C. Bauer)
High Density Packaging using Flip Chip Technology in Mobile Communication Equipment
Kazuto Nishida, Kazumichi Shimizu, Takashi Yui, Hajime Honma, Nobuya Matsumura, Matsushita Electric Industrial Co., Ltd.; Izumi Okamoto, Matsushita Electronic Components Co. Ltd.; Kouji Abe, Kouzou Takada, Tomiyo Ema, Matsushita Communication Industrial Co., Ltd.; Hideo Koguchi, Chie Sasaki, Nagaoka University of Technology

WA2: Integrated Passives in LTCC for RF, Microwaves and Wireless (J. Gipprich & F. Barlow)
Glass-Ceramic Module for 60GHz-Band Wireless Communication Systems
Kazuhiro Ikuina, Takeya Hashiguchi, NEC Corporation; Kenichi Maruhashi, Masaharu Itoh, Keiichi Ohata, Photonic and Wireless Devices Research Laboratories

WA3: Advanced Wirebond (L. Levine & W. Greig)
Fine Pitch 2[d] Bond Evaluation for PBGA Packages: Process Capability and Reliability Assessments
Tu Anh Tran, Burt Carpenter, Lois Yong, Greg Ridsdale, Dennis Ravenscraft, Fuaida Harun, Edwin George, Motorola Semiconductor Products Sector

WA4: Power Packaging (D. Hopkins & D. Kellerman)
Thick Silver Tape in Low Temperature Cofire Ceramic (LTCC) for Thermal Management
Peng Wang, W. Kinzy Jones, Yanqing Liu, Florida International University

WP1: Reliability of Novel CSP Structures (E. Vasvary & J. Cook)
Reliability Design and Experimental Work for Mirror Image CSP Assembly
Dongji Xie, Sammy Yi, Flextronics

WP2: Integrated Passive Technology with PWB & Thin Film Processing for RF and High Speed Applications
Thin Film Capacitors Embedded into High Density Printed Circuit Boards
Angus I. Kingon, Taeyun Kim, Paula Vilarinho, Jon-Paul Maria, North Carolina State University; Robert T. Croswell, Motorola Advanced Technology Center

WP3: Cu Wirebond and Reliability (M. Sheaffer & R. Keusseyan)
Wire Bonding to Advanced Copper-Low-K Integrated Circuits, the Metal/Dielectric Stacks and Materials Considerations
George G. Harman, Christian E. Johnson, NIST

continued on page 15

WP4: Lead Free Solders (R. W. Johnson & H. Neuhaus)
Solder Joint Reliability of BGA Package with Sn-Bi System Solder Balls
Toshiya Akamatsu, Yasuo Yamagishi, Fujitsu Laboratories Ltd.; Kazuyuki Imamura, Osamu Yamaguchi, Masaharu Minamizawa, Fujitsu Limited

THA1: Flip Chip (A. Strandjord & P. Garrou)
Lead-Free Solder Bump Technologies for Flip-Chip Packaging Applications
Zaheed S. Karim, Advanced Interconnect Techonology Ltd.; Rob Schetty, Shipley LLC

THA2: Modeling & CAD (L. Nguyen & R. P. Selvam)
Computer Modeling to Optimize the Heat Removal Capacity of the Micro-Jet Array
R. Panneer Selvam, Yangki Jung, Joseph Khater, S. Ang, A. Elshabini, University of Arkansas

THA3: Photonics (M. Wernle & P. Zulueta)
Optical Leak Testing of Hermetic Packages
John W. Newman, NorCom Systems Inc.

THA4: Advanced Thick Film Materials Technologies (H. Kellzi & M. Ehlert)
The Mechanism and Prevention of Conductor Fracture on Printed Multilayer Ceramic and Low Temperature Co-fired Ceramic (LTCC) Substrates
Jiming Zhou, Stephen Tsai, Jerry Badgett, Christine Coapman, Delphi Delco Electronics Systems

ICAPS 2002 Best Paper Awards

Best Paper of the Symposium

Session 7: High Density Packaging (L. Schaper)
Wafer Applied Underfills for Flip Chip Assembly
R. Wayne Johnson, Qing Wang, Fei Ding, Renzha Zhao, Auburn University; Larry Crane, Mark Konarski, Erin Yaeger, Afranio Torres, Rebecca Tishkoff, Paul Krug, Steve Bauman, Loctite Corporation; Marc Chason, Jan Danvir, Nadia Yala, Jing Qi, Prasanna Kulkanari, Motorola ATC

Outstanding Papers

Session 4: System Application (P. Zulueta & K. Steeves)
An Implementation of the GeoMat Design Methodology: Designing a Low-Cost Metal Laminate Integrated Duplexer/Antenna System
Ron J. Barnett, GeoMat Insights; Lou Manzione, Bell Labs, Lucent Technologies; Hui Wu, Big Bear Networks

IMAPS MARKETING FORUM

You're a microelectronics marketing professional. A salesperson. An applications engineer. You've just completed booth duty Wednesday morning, first day of the show. You're feeling pretty good about the contacts that you made, and nailed down a commitment from a longtime customer pursuit. Ahhh, the show is paying for itself. What to do now? Time to do email? Walk the show? Get a beer? Maybe lunch? See Denver? Watch a soap on the tube? I have a much better idea . . .

You're an exhibits attendee. Someone gave you a free pass to the exhibits. You've walked the show, shopped around and picked up some literature on some equipment and materials you need. You saw your competitor is introducing a new product – "hey, I did that 5 years ago!" You wished you paid for the full symposium but your boss said "no way". You really would like to get a quick overview of what's happening in this industry without breaking the bank. So you need to get more out of your day - I have a suggestion . . .

You're in management. The darn economy is just not cooperating. You've done analysis after analysis, forecast after forecast. Conclusion – you have no clue what is going to happen. You need your job – a job. You're thinking you need some new ideas, some insight, something to verify your thinking. I've got a resource for you to consider . . .

It is my great pleasure to welcome IMAPS 2002 attendees to the IMAPS Marketing Forum, being held Wednesday September 4, 2002 from 2:30 PM until 5:30 PM in the Colorado Convention Center Rooms 202 & 204. The forum is FREE (yes, I said FREE) to all IMAPS 2002 attendees and is sponsored by the Microelectronics Marketing Research Council (MMRC). This forum has been designed to inform attendees of key market trends impacting several markets and technologies of interest to IMAPS attendees. These invited speakers are a dynamic group of industry experts. At the conclusion of the presentations, a panel discussion will look to challenge the speakers and the audience to discuss and debate their views on the current and future state of various segments of the microelectronics market. See page 22 for session outline.

I look forward to seeing you at this special event.

Michael P. O'Neill
Marketing Forum Chair

student activities

Students, no relaxing at the Microelectronics Gold Rush! It's not too late to participate in these exciting, mind-stretching activities scheduled from Tuesday through Friday, September 3 - 6.

Professional Development Course
IMAPS is offering a **free students-only** half-day Professional Development Course (PDC). The course, entitled *Microelectronics Systems Packaging: Careers, Technologies and Markets* will be presented on Friday, September 6 from noon to 3 pm at the Adam's Mark Hotel. To register, please visit the IMAPS registration area.

Student Chapter Booth Competition
Wednesday morning, from 9 am - 11 am a panel of judges will evaluate the Student Chapter booths on several criteria, including general appearance, display diversity (curriculum, activities, and projects), technical knowledge, and overall exhibit professionalism. **The *Best Student Chapter Booth* will be announced at the Student/Industry Reception.**

Best Student Paper
Student papers will be evaluated on technical knowledge, presentation skills, written manuscript, and audience interaction. A *Best Student Paper* will be selected and the winning student will receive a certificate and recognition in *Advancing Microelectronics*.

Student/Industry Panel
The Student/Industry Panel is your chance to learn career development insights from top-level industry professionals. The Panel will be conducted on Wednesday afternoon from 3:00 to 4:30, in Room CCC: A112. Professionals from the electronics and optical networking equipment industries, industry recruiters, and engineering educators will describe and discuss how their education, interests and career experiences led to their current positions. Students will also learn current industry expectations and what they should be doing now for their long-term career development. Panel participants include: Andrew Goldstein, Network Photonics; Keith Baumgardner, Intel; Dr. Renjeng Su, University of Colorado at Denver; Dr. Jennie S. Hwang, H-Technologies Group; and Chuck Bauer, TechLead Corporation. Each panelist will speak for 10 – 15 minutes, followed by a Q & A session.

Student/Industry Reception
The Student/Industry Reception will immediately follow the Student/Industry Panel. Students will have the opportunity to network one-on-one with the industry panelists and each other. Refreshments will be served.

Student Plant Tours
On Thursday morning we'll hop a bus and head for Longmont and Boulder to get a look at the Colorado photonics industry. We'll tour the Colorado Advanced Photonics Technology (CAPT) Center and Picolight. The CAPT Center delivers prototyping, precision metrology, environmental testing, and use of photonics equipment and facilities for photonics industry clients. Picolight designs, manufactures and delivers high-speed optical subsystems to original equipment manufacturers (OEMs) of telecom switch, storage area, enterprise and metro/access network equipment. **Bus will depart from the lobby of the Adam's Mark Hotel.**

Employment Center
An Employment Center will be offered at the IMAPS 2002 Symposium. The Employment Center will post job openings (including internships), collect resumes, offer on-site interview space and help schedule interviews at the employer's request. At your request, each resume submitted will be entered into the IMAPS Online Marketplace. Take advantage of this no fee service; it's a great way to gain immediate face-to-face contact with potential employers. Tables will also have company literature available. **See page 17 for additional information.**

Questions: Jim Leonard, Student Activities Chair or Doug Paul, IMAPS Staff, at the IMAPS Membership booth.

Student/Industry Panel & Reception

Wednesday, September 4, 2002
3 pm - 5:30 pm
CCC: Room A112

IMAPS 2002 Introduces the Employment Center

It is with great pleasure that IMAPS 2002 will provide for the first time, an Employment Center. Given the current market conditions, can you not afford to have your resume updated and potentially available? Take advantage of this no-fee service; it is a great way to gain immediate face-to-face contact with potential employers/employees.

The Employment Center posts job openings, collect resumes, offers on-site interview space and helps schedule on-site interviews at the potential employer's request. Postings may be internships or anything from entry level to executive management. Your resume will only be submitted to those companies you apply for and will be kept confidential. If you request after the convention, we can also post your resume on the IMAPS Online Marketplace web service.

The Employment Center is located in **Room A111** of the Colorado Convention Center.

It's on your way to the exhibits, so stop by to post a job, peruse the postings or just to say Hi!

Employment Center Hours (*Open half hour past exhibits*):

Wednesday, September 4th - 9:00 a.m. – 6:30 p.m.
Thursday, September 5th - 9:00 a.m. – 5:30 p.m.
Friday, September 6th - 8:00 a.m. – 12:30 p.m.

Student Plant Tour

Thursday, September 5

- Colorado Advanced Photonics Technology Center (CAPT)
- Picolight

Bus departs from Adam's Mark Hotel at 8 am and returns approximately 11:30 am

FOR STUDENTS ONLY! - FREE
PROFESSIONAL DEVELOPMENT COURSE

FRIDAY, SEPTEMBER 6
ADAM'S MARK HOTEL
ROOM: PLAZA COURT A
Noon - 3 PM

Microsystems Packaging: Technologies, Markets and Careers

Instructors: Prof. Rao R. Tummala, Petit Chair Professor, Director NSF-PRC, GRA Scholar, Georgia Institute of Technology; Janet K. Lumpp, University of Kentucky; Leyla Conrad, Georgia Institute of Technology

This three-hour course will present the global microelectronics market, past and future technologies that constitute this market, educational opportunities that are available and career prospects for a lifelong career around the world in various industries.

PDCs

professional development courses

Tuesday, September 3

Professional Development Courses (T1 - T10), will be held at the Colorado Convention Center (CCC) 9 am - 5 pm

T1 – CCC: A202
Wire Bonding in Microelectronics
Instructor: George G. Harman, National Institute of Standards and Technology

T2 – CCC: A204
Metal Plating for Electronics
Instructor: Michael McChesney, McChesney, Inc.

T3 – CCC: A206
Technology of Screen Printing
Instructors: Art Dobie, SEFAR America & Rudy Bacher, DuPont

T4 – CCC: A208
Implementing Microvias and Embedded Passives
Instructor: Rolf E. Funer, Funer Associates

T5 – CCC: A210
Advanced Organic Substrate Package Design & Manufacturing for RF & Broadband Applications
Instructor: Hassan Hashemi, Conexant Systems, Inc.

T6 – CCC: A102
Fundamentals of Fabrication and Packaging of MEMS and Related Micro Systems
Instructor: Ajay P. Malshe, Ph.D., University of Arkansas - HiDEC

T7 – CCC: A104
Flip Chip and CSP Technologies – Constructions, Materials, Assembly and Reliability
Instructor: R. Wayne Johnson, Ph.D., Auburn University

T8 – CCC: A106
Lead Free Soldering – Status Review and Process Challenges
Instructor: Ning-Cheng Lee, Indium Corporation of America

T9 – CCC: A108
Design Failure Mode Effects Analysis for Reducing Design Defects
Instructor: Mary McDonald, ISO/QS, Inc.

T10 – CCC: A110
RF/Microwave Hybrids: Basics, Materials and Processes
Instructors: Fred D. Barlow and Aicha Elshabini, University of Arkansas

Tuesday Courses Only

PDC Refreshment Breaks
10 –10:30 a.m. and 3 –3:30 p.m.
CCC: A207

PDC Luncheon
Noon – 1 P.M.
CCC: A207

PDC Reception
5 – 6 p.m. • Tuesday, Sept. 3rd
CCC: A207

Friday, September 6

Professional Development Courses (F1 - F9), will be held at the Adam's Mark Hotel Noon – 6 pm
Lunch at 11 AM: Plaza Ballroom A
(*Fri. PDC Attendees/Instructors ONLY*)

F1 – Plaza Court 1
Process Engineering Fundamentals
Instructor: Thomas J. Green, National Training Center for Microelectronics

F2 – Plaza Court 2
Advanced Materials for Microelectronics, Optoelectronic and MEMS/MOEMS Packaging and Thermal Management
Instructor: Dr. Carl Zweben, Advanced Packaging Materials and Composites Consultant

F3 – Plaza Court 3
Fundamentals of Hybrid Microelectronics
Instructor: Jerry Sergent, Ph.D.

F4 – Plaza Court 4
Integrated Circuit Packaging Trends and Assembly Options - Issues and Concerns
Instructor: William J. Greig, Greig Associates

F5 – Plaza Court 5
Low Temperature Cofired Ceramics (LTCC)
Instructors: Aicha Elshabini and Fred D. Barlow, University of Arkansas

F6 – Plaza Court 6
Microelectronic Thermal Management
Instructor: Al Krum, Consultant

1/2 Day Courses: F7 - F9

F7 – Plaza Court 7
Noon - 3 p. m.
Lead-Free Solders – Technology, Selection and Applications
Instructor: Dr. Jennie S. Hwang, H-Technologies Group, Inc.

F8 – Plaza Court 7
3 pm - 6 pm
Solder Joint Reliability - Manufacturing Perspectives
Instructor: Dr. Jennie S. Hwang, H-Technologies Group, Inc.

F9 – Plaza Court 8
Noon - 3 p.m.
Microsystems Packaging: Technologies, Markets and Careers
Instructors: Prof. Rao R. Tummala, Petit Chair Professor, Director NSF-PRC, GRA Scholar, Georgia Institute of Technology; Janet K. Lumpp, University of Kentucky; Leyla Conrad, Georgia Institute of Technology

Wednesday, September 4

WA1 - Room A209
High Density Substrates & Boards

Chairs: Rajen Chanchani, Sandia National Laboratories; Andrew Strandjord, IC Interconnect

8 am - 11:25 am

Several advanced, high density substrate and board technologies will be presented. Some of the innovative technologies that will be included are advanced boards with liquid crystal polymer dielectric, a new stacked via technology, a new organic laminate technology for better electrical performance at over GHz frequencies, high interconnect density organic boards for UNIX servers, copper nano-composites for PWBs and polymer based photo-imageable dielectric.

8:00 The Processing and Assembly of Liquid Crystalline Polymer Printed Circuits
Tan Zhang, R. Wayne Johnson, Auburn University; Brian Farrell, Foster Miller, Inc.; Michael St. Lawrence, Rogers Corporation

8:25 High-Performance Flip-Chip BGA based on Multi-Layer Thin-Film Packaging Technology
Tadanori Shimoto, Katsumi Kikuchi, Hirokazu Honda, Keiichiro Kata, Kazuhiro Baba, Koji Matsui, NEC Corporation

8:50 A New Stacked-Via Formation Technology for High-Density Build-Up Packages
Tomoyuki Abe, Nobuyuki Hayashi, Motoaki Tani, Yasuhiro Yoneda, Fujitsu Laboratories Ltd.

9:15 Break

9:45 Wire Bonding Study of Gold Conductors for LTCC Applications
Cristina Lopez, Liang Chai, Aziz Shaikh, Vern Stygar, Ferro Electronic Material Systems

10:10 Packaging Technology for High Performance UNIX Server
Masateru Koide, Jie Wei, Akihiko Fujisaki, Yoshinori Uzuka, Masahiro Suzuki, Fujitsu Limited

10:35 PAMAMOS Copper Nanocomposite Coatings for the Fabrication of Printed Wiring Boards
David A. Dalman, Dendritech, Inc.; Petar R. Dvornic, Michigan Molecular Institute; M. Frederick Hoover, Hoover Technologies; Tony Lentz, Florida CirTech, Inc.

11:00 Cardo Polymer Based Photo Imageable Dielectric
Masahiko Takeuchi, Shinji Inaba, Hironobu Kawasato, Kazuhiko Mizuuchi, Takero Teramoto, Nippon Steel Chemical Co., Ltd.

WA2 - Room A207
LTCC Manufacturing Issues

Chairs: Ken Kuang, Kyocera America, Inc.; Aziz Shaikh, Ferro Electronic Materials

8 am - 11:25 am

The continuous drive of making LTCC products better and cheaper has challenged many engineers and scientists alike to address manufacturing issues. This session discusses two pioneering ways to achieve high-density circuit traces, three novel LTCC material systems, one new process monitoring technique and an innovative manufacturing method to make LTCC monolithic transformers.

8:00 Cold Low Pressure Lamination of LTCC's
Andreas Roosen, University of Erlangen - Nuremberg

8:25 Fine Line LTCC-Structures by Direct Gravure Printing (DGP) Method
Juha Hagberg, Marko Kittilä, Eino Jakku, Seppo Leppävuori, University of Oulu

8:50 Evaluation of New CaRuO3 Thick Film Resistor Formulations Compatible with LTCC Co-Firing
Randy Klein, W. Kinzy Jones, Florida International University

9:15 Break

9:45 Characterization of Unrestrained Zero Shrink LTCC Material System for Volume Production of RF LTCC Modules
Michael Ehlert, Barbie Spenser, National Semiconductor Corporation; Frans Lautzenhiser, Edmar Amaya, Heraeus Inc. CMD

10:10 Compliant Dielectric and Magnetic Materials for Buried Components
A. H. Feingold, M. Heinz, R. L.Wahlers, Electro-Science Laboratories

10:35 Optical Dilatometer for Insitu Measurements of Warpage Effects during Firing of LTCC Multilayer Structures
Matthias Wagner, Andreas Roosen, Alfons Stiegelschmitt, University of Erlangen - Nuremberg; Dieter Schwanke, Micro Systems Engineering; Franz Bechtold, VIA Electronic GmbH

11:00 Low Profile LTCC Transformers
R. L. Wahlers, C. Y. D. Huang, M. R. Heinz, A. H. Feingold, Electro Science Laboratories; John Bielawski, George Slama, Midcom, Inc.

WA3 - Room A205
MEMS & MEMS Applications

Chairs: David Galipeau, South Dakota State University; Janet Lumpp, University of Kentucky

8 am - 11 am

The focus of this session is on advancements in MEMS including pressure sensing, GaAs structures and MEMS packaging.

8:00 Design by Analysis of a MEMS Pressure Sensor
Ryszard J. Pryputniewicz, Cosme Furlong, Worcester Polytechnic Institute; Emily J. Pryputniewicz, Institute of Defense Analyses

8:25 Mechanically Fixed and Thermally Isolated Micromechanical Structures for GaAs Heterostructure Based MEMS Devices
T. Lalinsky, S. Hascik, Z. Mozolova, E. Burian, M. Krnac, I. Kostic, L. Matay, Slovak Academy of Sciences; M. Tomaska, J. Skriniarova, Slovak University of Technology; M. Drzik, International Laser Center

8:50 Laser-Assisted Selective Bonding for Wafer-Level & Chip-Scale Vacuum Packaging of MEMS and Related Micro Systems
Yi Tao, Ajay P. Malshe, W. D. Brown, University of Arkansas

9:15 Break

9:45 Reliability Testing of Flexible Circuit-Based RF MEMS Switches
Simone Lee, Ramesh Ramadoss, Victor Bright, K.C. Gupta, Y.C. Lee, University of Colorado

10:10 One Packaging Technique of Exposed MEMS Sensors
Tim (Zhigang) Lin, Rick Yoon, IJ Research, Inc.

10:35 Strategies for Successfully Integrating MEMS Die onto Laminate
Robert Dean, R. Wayne Johnson, Holly Garrison, Nicole Schutz, Auburn University; Mike Kranz, Morgan Research Corporation; Ron Legowik, U.S. Army Aviation & Missile Command; Bill Bowers, Bill Payne, IITRI

technical program

WA4 - Room A201
Area Array Interconnects

Chairs: Roupen Keusseyan, DuPont Microcircuit Materials; Leonard Schaper, University of Arkansas

8 am - 11:25 am

Surface mount technologies rely heavily on solder interconnect methods. To achieve acceptable service life, both materials properties and the application environment must be factored into packaging of electronics for specific applications. These papers present some of the significant aspects of packaging using solder interconnections.

8:00 Design and Characterization of a 10GHz Organic BGA Package
Richard Lynn, Maxtek Components Corporation

8:25 Qualification of Plastic Ball Grid Array Packages for Space Applications
Thomas Estes, Yoshio Saito, TRW Space and Electronics

8:50 A Study of Solder Joint Reliability of TFBGA Assemblies with Fresh and Reworked Solder Balls
Po-Jen Zheng, J. Z. Lee, K. H. Liu, J. D. Wu, S. C. Hung, Advanced Semiconductor Engineering, Inc.

9:15 Break

9:45 Long Time Reliability of Flip Chip Interconnections on Flexible Substrates
Barbara Pahl, Christine Kallmayer, Technical University of Berlin; Rolf Aschenbrenner, Herbert Reichl, Fraunhofer Institute of Reliability and Microintegration IZM Berlin

10:10 Placement and Reflow of Solder Balls for FC, BGA, Wafer-Level-CSP, Optoelectronic Components and MEMS by using a new Solder Jetting Method
Thomas Oppert, L. Titerle, E. Zakel, Pac Tech-Packaging Technologies GmbH; G. Azdasht, Smart Pac GmbH; T. Teutsch, Pac Tech-Packaging Technologies USA, Inc.

10:35 Measurements and Simulation of SMT Components
Ryszard J. Pryputniewicz, Cosme Furlong, Worcester Polytechnic Institute; David Rosato, Harvard Thermal, Inc.

11:00 SMT: Modeling and Uncertainty Analysis of a J-Lead Attachment
Ryszard J. Pryputniewicz, Cosme Furlong, Worcester Polytechnic Institute; Dariusz R. Pryputniewicz, Draper Laboratory

WA5 - Room A202/204
System Packaging

Chairs: Christian M. Val, 3DPlus; Timothy Lenihan, Consultant

8 am - 11 am

The dictionary defines a system as "a group of things or parts connected in some form to make a whole." Systems Packaging is essentially the electromechanical process or technique of connecting the parts of the system together. These papers demonstrate various examples of the latest thinking in systems packaging that allow for high density integration.

8:00 System-in-Package (SiP) Design for Higher Integration
Nozad Karim, Amkor Technology Inc.; Tania Van Bever, Alcatel Microelectronics

8:25 Wafer Level Batch Transfer Process of RF MEMS Passive Device using PDMS
Sang Won Park, Kabseog Kim, Jeong-Bong Lee, The University of Texas at Dallas; Wendell Alan Davis, The University of Texas at Arlington

8:50 High-Density Packaging for Wrist-Wearable Medical Devices
Etienne Hirt, Michael Scheffler, Art of Technology

9:15 Break

9:45 Very High Speed 3D "System in Package"
Christian Val, Marie-Cecile Vassal, Olivier Lignier, Michel Mardiguian, 3DPlus

10:10 System-on-Package (SOP): Next Generation Convergent Microminiaturized Microsystems Solution
Rodolfo L. Gacusan, Intel Technology Philippines, Inc.

10:35 Modular Systems for Sensor Integration
Matthias Klein, Hermann Oppermann, Rolf Aschenbrenner, Herbert Reichl, Fraunhofer IZM – Berlin

Awards Ceremony

Wednesday, September 4

11:40 AM - 12:15 PM

Colorado Convention Center

Exhibit Hall A

WP1 - Room A209
Recent Developments in Wafer Level CSPs

Chairs: Curtis Zwenger, Amkor Technology; Li Wetz, Motorola SPS

2:30 pm - 5:30 pm

Wafer Level CSP (WLCSP) technologies hold tremendous promise for reducing the form factors of small integrated circuits and other passive devices with I/O counts typically below 50 I/O. Since low I/O leadframe based SMT packages are not particularly space efficient, the migration of these modest components to wafer scale can have quite a dramatic influence on product minituarization. This session will outline advancements that are being made in the development of wafer scale solutions including traditional ICs and MEMS to name a few as well as to highlight recent developments in process development and WLCSP reliability.

2:30 Development of an Low Cost Wafer Level Flip Chip Assembly Process for High Brightness LEDs using the AuSn Metallurgy
Gordon Elger, Rafael Jordan, Maria v. Suchodoletz, Hermann Oppermann, Fraunhofer Institute for Reliability and Microintegration

2:55 Materials for 300 mm Wafer Level Packaging Technologies
Michael Toepper, Christina Lopper, Veronika Glaw, Karin Samulewics, Lothar Dietrich, Herbert Reichl, Fraunhofer-IZM and Technical University of Berlin; Albert Achen; The Dow Chemical Company

3:20 Design and Reliability of a New WL-CSP
Li Wetz, Beth Keser, Jerry White, Motorola SPS

3:45 Break

4:15 Solder Joint Reliability of Wafer Scale CSP Packages
Joe Smetana, Alcatel USA; Bob Sullivan, HDP User Group International, Inc.

4:40 Experimental and Analytical Study on Large Passivation Opening to Improve Solder Joint Reliability for micro SMD Packages
Vivek Arora, Li Zhang, Luu Nguyen, Nikhil Kelkar, National Semiconductor Corporation

5:05 New Cost Effective and Low Profile Wafer Level CSP
Masamitsu Ikumo, Hirohisa Matsuki, Yositaka Aiba, Tetsuya Fujisawa, Mitsutaka Sato, Fujitsu Limited; Mario Aguirre, Fujitsu Microelectronics America Inc.

WP2 - Room A207

Packaging Materials

Chairs: Herbert J. Neuhaus, NanoPierce Connection Systems, Inc.; Michael E. Wernle, NanoPierce Card Technologies, GmbH

2:30 pm - 5:30 pm

This session presents cutting-edge developments at the intersection of the two most dynamic areas of packaging. Previously wafer-level packaging and lead-free solders have been generally considered separately. Now, as these emerging areas mature, their interactions come to the fore as critical issues for study.

2:30 New Materials for High Performance No-Flow Underfill
Kathleen M. B. Gross, Steve Hackett, Donald G. Larkey, William J. Schultz, Wendy Thompson, 3M

2:55 Effects of Flexibilizers on the Properties of Liquid Microelectronic Encapsulation Materials
Shaoqin Gong, Michael Todd, Henkel Loctite

3:20 Thermal Characterization of High Temperature Reflow Compatible Epoxy Molding Compound used in Lead-Free Packaging
Dennis Prem Kumar Chandran, C. K. Chee, Y. He, T. Sterret, H. P. Sow, A. V. Rudge, A. S. Abdullah, Intel Technology (M) Sdn Bhd

3:45 Break

4:15 Investigation of Electroplated Ni and Ni-Cu Alloy UBM (Under Bump Metallurgy) with Lead-Free Solders for Flip Chip Packages
Su-Hyeon Kim, Jong Yeon Kim, Jin Yu, KAIST

4:40 Development of Single Pass Reflow Encapsulant for Lead Free Solder Bump
Lin Xin, Rich Kraszewski, Jin Liu, Jennifer Allen, Seach Hwee Goh, Chad Showalter, Linda Wong, Kester-Northrop Grumman

5:05 Phase Transformation and Residual Stress Evolution in Electroless Ni-P UBM used in Low Cost Flip Chip Technology
J. Y. Song, Jin Yu, KAIST

WP3 - Room A205

RF Design and Measurements & Wireless Applications

Chairs: F. D. Barlow, University of Arkansas; John Gipprich, Northrop-Grumman

2:30 pm - 5:30 pm

This session addresses design and measurements of RF and wireless applications. These applications include RF MEMS, LMDS, RF radio links, LTCC and embedded passives, multiplexer/ demultiplexer package, and T/R modules.

2:30 RF MEMS: Modeling and Simulation of Switch Dynamics
Ryszard J. Pryputniewicz, Cosme Furlong, Worcester Polytechnic Institute; Patrick W. Wilkerson, Andrzej J. Prekwas, CFD Research Corporation

2:55 LMDS Applications and RF Radio Links go for SMD Based Module Technology - Reality, Experience and Future Trends
Martin Oppermann, EADS Deutschland GmbH

3:20 The RF Impact of Coupled Component Tolerances and Gridded Ground Planes in LTCC Technology and their Design Countermeasures
George Passiopoulos, Kevin Lamacraft, Nokia Networks

3:45 Break

4:15 Microwave Module Design with HeraLock™ HL2000 LTCC
Frans Lautzenhiser, Edmar Amaya, Peter Barnwell, Jim Wood, Heraeus CMD

4:40 The New Thick-Film Frequency Electronic Ballasts for Low Power Discharge Lamps
Janusz J. Gondek, Private Institute of Electronic Engineering; St. Kordowiak, W. Mysinski, Cracow University of Technology; B. Kawa, J. Kocol, Technical School of Communications; P. Gebik, P.P.U.H "GECO" Ltd.; P. Szatynski, Cracow Electronics Works "TELPOD"

5:05 Embedded Passives and T/R Module for Millimeter-Wave Fabricated by the Photoimageable Thick Film Process
Seong-Dae Park, Young-Shin Lee, Chan-Sei Yoo, Erick Kim, Jong-Chul Park, Korea Electronics Technology Institute

WP4 - Room A201

Thermal Management

Chairs: Ajay P. Malshe, University of Arkansas; Matt Gordon, University of Arkansas

2:30 pm - 5:30 pm

Demands and advances in the thermal management area are highlighted in this session through various presentations by leading researchers on topics such as miniaturized heat pipes, reliability of high power optical devices, analysis and modeling.

2:30 Thermal Modeling and Measurement of Large High Power Silicon Devices with Asymmetric Power Distribution
Jeffrey Deeney, Hewlett Packard Company

2:55 Thermally Enhanced PBGA: Package Characterization, Thermal Performance and Reliability at High Temperatures (Pb-free)
Swaminath Prasad, Flynn Carson, Bret Zahn, T. K. Lee, H. T. Lee, ChipPAC Incorporated

3:20 Packaging and Thermal Management for kW/cm2 Microwave Amplifiers
Tim (Zhigang) Lin, Rick Yoon, IJ Research, Inc.

3:45 Break

4:15 Development of a Reworkable Film in High Performance Thermal Management Applications
Andrew P. Collins, Chih-Min Cheng, Emerson & Cuming

4:40 Heat Transport Performance of Micro Heat Pipe with Cross Section of Polygon
Gunn Hwang, Seok Hwan Moon, Chi Hoon Jun, Youn Tae Kim, ETRI

5:05 Heat Sink Design Optimization for Optical Transponders
Z. F. Shi, Albert C. W. Lu, Y. M. Tan, K. H. Ang, Singapore Institute of Manufacturing Technology; Ronson Tan, Eric Tan, E2O Communications Pte Ltd.

WP5 - Room A202/204
Marketing Forum*

Chair: Mike O'Neill, Heraeus Inc. - CMD
2:30 pm - 5:30 pm

It is my great pleasure to welcome IMAPS 2002 attendees to the IMAPS Marketing Forum. The forum is FREE (yes, I said FREE) to all IMAPS 2002 attendees and is sponsored by the Microelectronics Marketing Research Council (MMRC). This forum has been designed to inform attendees of key market trends impacting several markets and technologies of interest to IMAPS attendees. These invited speakers are a dynamic group of industry experts. At the conclusion of the presentations, a panel discussion will look to challenge the speakers and the audience to discuss and debate their views on the current and future state of various segments of the microelectronics market.

***Papers for this session are not in the Proceedings/CD. Handouts will be provided at the door.**

2:30 Welcome and Introductions

2:35 Microelectronics Marketing Research Council Overview
Rick Sigliano, Kyocera, Chairman, MMRC Steering Committee

2:45 Integrated Passive Components Market Overview
Dennis Zogbi, Paumanok Group
A market overview will be given of passive network markets, technologies & opportunities including thick film SIPs and DIPs, LFRs and multichip arrays, and thin film integrated passive devices. Paumanok will also discuss the separate trends in LTCC and other trends in integration, including integration trends in circuit protection components (co-fired ceramics in varistors, thermistors and electronic fuses). The focus of this presentation will be the historical penetration of these devices and the future market potential, with emphasis upon why the array was successful and why more complex integrated passives have not grown as fast. The primary message of the presentation will be that component price rules the day, regardless of increased component functionality and customer savings on conversion costs.

3:15 Optoelectronics Market Overview
Warner Andrews, Jr., Picolight

3:45 Break

4:00 A Vision for the Future of Automotive Electronics
D.H.R. Sarma, Deplhi Automotive Systems
This talk will chronicle the growth of electronics in the automobile, provide a glimpse into the emerging electronics applications in the automobile, and will emphasize the evolving "convergence of consumer electronics and automotive electronics." Special attention will be given to the impact of these applications on technologies of interest to IMAPS attendees. The cost and performance challenges posed by the next generation automotive electronics in the areas of electronic materials and packaging technologies will be highlighted.

4:30 CII Technology Roadmap 2002
Howard Imhoff, Midas Vision Systems
An overview with highlights of the recently completed 2002 Ceramic Interconnect Initiative Technology Roadmap will be presented. This effort was completed in conjunction with the IPC and NEMI roadmapping efforts, each of which include a version of this document as the INTERCONNECTION SUBSTRATES-CERAMIC chapter. The roadmap was written by industry experts comprising all disciplines of ceramic interconnect technology. Current, leading edge, and state of the art characteristics of each ceramic discipline are described. Cost models and performance comparisons are made with selected organic substrates. Technology trends, critical issues, and paradigm shifts are discussed. Gaps and needs assessments are identified and potential solutions are listed.

5:00 Q&A / Panel Discussion
Michael P. O'Neill, Heraeus Incorporated, Circuit Materials Division

Thursday, September 5

THA1 - Room A209
3D and High Performance Packaging in Japan (*Japanese Translated Session*)

Chairs: Yuzo Shimada, NEC Corporation; Charles E. Bauer, TechLead Corporation
8 am - 11 am

Building on the road map for high density packaging presented in the first paper, this session demonstrates the significant advances in three dimensional semiconductor packaging concepts and technology taking place in Japan. These innovations range from the high density substrate technologies necessary to accomplish three dimensional packaging through the intricate design concepts under consideration to the complex assembly processes required.

8:00 High Density Packaging Technology Research & Development Roadmap in Japan
Manabu Bonkohara, ASET-Association of Super-Advanced Electronics Technologies

8:25 High-Density System-On-Film (SOF) using Two-Metal Layer Tape
Yasuhisa Yamaji, Takehiro Suzuki, Yasuhiko Tanaka, Nakae Nakamura, Kenji Toyosawa, Yasunori Chikawa, Sharp Corporation

8:50 Investigation of Fundamental Technology for 3D Assembly
Kei Murayama, Mitsutoshi Higashi, Mitsuharu Shimizu, Shinko Electric Industries Co., LTD.

9:15 Break

9:45 Ultra-high-density Interconnection Technology of 3-dimensional Packaging
Kenji Takahashi, Mitsuo Umemoto, Kazumasa Tanida, Yoshihiko Nemoto, Yoshihiro Tomita, Masamoto Tago, Manabu Bonkohara, ASET-Association of Super-Advanced Electronics Technologies

10:10 Thermosonic Flip Chip Bonding for Low Cost Packaging
Taizo Tomioka, Tomohiro Iguchi, Ikuo Mori, Masayuki Saito, Toshiba Corporation

10:35 Ultra-Thin & High-Density Packaging using both Sides Flip Chip Technology
Kazuto Nishida, Kazumichi Shimizu, Michiro Yoshino, Yoshihiko Yagi, Kazuhiro Uji, Matsushita Electric Industrial Co., Ltd.; Hideo Koguchi, Chie Sasaki, Nagaoka University of Technology

THA2 - Room A207
RF and Microwaves Components Realization

Chairs: A. Elshabini, University of Arkansas; Daniel Amey, Dupont Microcircuit Materials
8 am - 11 am

This session describes RF and Microwaves components realization for MEMS switch, MEMS variable capacitor, LTCC filter, a slit cavity resonator, and microwave power amplifier. Impact of fine line technique and processing parameters on electrical properties and accurate prediction of these properties are covered in the session.

8:00 Mechanical and Electrical Design of a Novel RF MEMS Switch for Cryogenic Applications
H. Zhang, Victor M. Bright, Y. C. Lee, K. C. Gupta, University of Colorado at Boulder

8:25 A Frequency Tunable Half-Wave Resonator using a MEMS Variable Capacitor
Patrick Bell, Nils Hoivik, Victor Bright, Zoya Popovic, University of Colorado at Boulder

8:50 Accurate Prediction of Microstrip Impedance and Attenuation at Millimeter-Wave Frequencies
Didier Cottet, Janusz Grzyb, Gerhard Troester, ETH Zurich

9:15 Break

9:45 An Investigation of the Properties of New-Developed LTCC Materials for their use in Microwave Circuit
Kazunari Watanabe, Kastutoshi Nakayama, Hiroshi Usui, Asahi Glass Co., Ltd.

10:10 Multi-Layer Thick-Film Microwave Components and Measurements
Zhengrong Tian, Middlesex University; Charles Free, Colin Aitchison, University of Surrey; Peter Barnwell, James Wood, Heraeus Circuit Materials Division

10:35 A High Performance 5.8 GHz Power Amplifier Design Enabled by a New Microwave Power Package
Steven C. Evangelista, John W. Roman, SatCon Electronics

THA3 - Room A205
Power Packaging Technologies

Chairs: Douglas C. Hopkins, University at Buffalo; Dave Kellerman, Material Solutions

8 am - 10:35 am

This session provides applications and techniques starting with a 55kW automotive power module, followed by an update on polyimide flex to interconnect power chips in a very high density module. Ceramic is still a major development area with new characterizations reported in thermal vias imbedded into LTCC and new resistor formulations to combat cost increases. Finally, two papers provide detailed technical analysis of degradation due to high power effects.

8:00 Packaging and AIPM
Y. J. Chen, J. Mookkeen, V. Temple, Silicon Power Corporation

8:25 A High Performance Polymer Thin Film Power Electronics Packaging Technology
Ray Fillion, Eladio Delgado, Paul McConnelee, Richard Beaupre, GE Global Research Center

8:50 High Density Thermal Vias in Low Temperature Cofire Ceramic (LTCC)
Ravindra Kandukuri, Yanquing Liu, Marc Zampino, W. Kinzy Jones, Florida International University

9:15 Break

9:45 New Low Cost Surge Resistive Inks
Michail Moroz, Aziz Shaikh, Ferro Electronic Material Systems

10:10 Measurement and Effects of High Electrical Current Stress in Solder Joints
Hua Ye, Douglas C. Hopkins, Cemal Basaran, University at Buffalo, SUNY

THA4 - Room A201
Sensors Packaging

Chairs: David Galipeau, South Dakota State University; Richard Gehman, Honeywell, Inc.

8 am - 11 am

This session covers advancements in thick film sensors as well as new packaging methods for sensor arrays, MEMS and IR detection.

8:00 A Study of Factors Affecting Characteristics of Thick Film NTC Thermistors
David J. Nabatian, KOARTAN Microelectronic Interconnect Materials

8:25 An Evaluation of Materials and Processes Employed in the Construction of Novel Thick Film Force Sensors
Yulan Zheng, John Atkinson, Zhige Zhang, University of Southampton; Russ Sion, C-Cubed Limited

8:50 Investigations of Thick-Film Resistors on different Substrates for Strain-Gauge Applications
Darko Belavic, HIPOT; Marko Hrovat, Andreja Bencan, Jozef Stefan Institute; Walter Smetana, Heinz Homolka, Roland Reicher, Vienna University of Technology; Leszek Golonka, Andrzej Dziedzic, Jaroslaw Kita, Wroclaw University of Technology

9:15 Break

9:45 Fluxless High-Vacuum Packaging of MEMS and IR Sensors
Cory Jenkins, SST International

10:10 A Novel Flex Circuit Area-Array Interconnect System for a Catheter-Based Ultrasound Transducer
Jeff Strole, Scott Corbett, MicroConnex, Inc.; Warren Lee, Edward Light, Stephen Smith, Duke University

10:35 The Package and Thermal Management of an Infrared (IR) Sensor
Tim (Zhigang) Lin, Rick Yoon, IJ Research, Inc.

THA5 - Room A202/204
Advanced Interconnect and Wire Bonding

Chair: Lee Levine, Process Solutions Consulting

8 am - 11:25 am

Interconnections have greatly broadened in scope of late. Wire bonds continue to be the most used interconnection method, but new methods and non-traditional applications continue to appear. This session gives recent advancements in both wire bonding and in some less traditional means of interconnection.

8:00 Anisotropically Conductive Adhesive for Flip Chip on Paper Assembly
Jad S. Rasul, William Olson, Motorola Inc.

8:25 Comparison of 60-kHz and 100-kHz Wirebonding on Organic and Inorganic Substrates
H. K. Charles, Jr., K. J. Mach, S. J. Lehtonen, A. S. Francomacaro, J. S. DeBoy, R. L. Edwards, The Johns Hopkins University/APL

8:50 Elevated Temperature Failure Mechanisms in Au-Al Ball Bonds
Narendra Noolu, John Lippold, The Ohio State University; Mark Klossner, Kulicke & Soffa Industries; Kevin Ely, Edison Welding Institute; William Baeslack, Rensselaer Polytechnic Institute

9:15 Break

9:45 Providing Process Solutions for Technological Challenges in Hybrid Applications
Ivy Wei Qin, Guy Frick, Kulicke and Soffa

10:10 TiN Coating - A Solution for High Temperature Interconnects
Hee Yeon Ryu, R. A. Saravanan, Rishi Raj, University of Colorado at Boulder

10:35 Laser Processing of Flexible Substrates
Peter Gordon, Richard Berenyi, Budapest University of Technology and Economics

11:00 Potential of Flip Chip Technologies for Chip Stacking Applications
Holger Woerner, Infineon Technologies AG

THP1 - Room A209

Automotive Electronics

Chair: D. H. R. Sarma, Delphi

2 pm - 4:35 pm

According to Global Information, Inc., worldwide demand for OEM automotive electronics will expand 6.8 percent per year to $97.5 billion in 2005. This specially designed session explores some of the latest technical developments in methods for micro machining sensor arrays; contains information about new polymeric materials used for environmental protection of sensitive electronics in severe operating environments and provides a comprehensive look at developments in lead-free packaging for automotive electronics.

2:00 A Micromachined Gas Sensor Array for Automotive Emissions
Jason D. Sternhagen, Kraig D. Mitzner, Eric J. Berkenpas, Wade Kempf, David W. Galipeau, South Dakota State University

2:25 An Evaluation of Materials for the Environmental Protection of Automotive Sensors
K. L. Pearce, E. M. Walker, J. Luo, R. A. Schultz, Emerson & Cuming

2:50 Packaging Technologies for Automotive Electronics in the Lead-free Era
Hans Danielesson, MIKROELEKTRONIK KONSULT AB

3:15 Break

3:45 Reliability of Small BGAs in the Automotive Environment
Jeffrey C. Suhling, R. Wayne Johnson, John L. Evans, Nokibul Islam, Jing Liu, Shyam Gale, Auburn University; James R. Thompson, DaimlerChrysler - Huntsville Electronics

4:10 AMB Ceramic Substrates, A Conventional Alternative to Unconventional Thermal Requirements
Keith Easler, Kyocera America Inc.

THP2 - Room A207

Thick Film I

Chair: Richard Sigliano, Kyocera America, Inc.

2 pm - 5:25 pm

This session discusses topics from high temperature semiconductor materials for packaging of MEMS devices to a variety of thick film printing materials for AlN substrates and fine line processing. Also of interest to the thick film and quality engineer is a paper on Lead-free thick film resistor materials and characterization. Rounding out the session is a study of microvia fabrication in conjunction with LTCC materials.

2:00 Silicon Carbon-Nitride Ceramics - A High Temperature Semiconductor Material for MEMS Applications
R. A. Saravanan, Li-Anne Liew, Victor M. Bright, Rishi Raj, University of Colorado at Boulder

2:25 New Lead-Free Thick Film Resistors
J. Hormadaly, Ben-Gurrion University of the Negev

2:50 MCM- D/C Based on Cu/ BCB Thin Film and LTCC: Lessons Learned
Fred Barlow, Michael Glover, Jeff Mincy, Errol Porter, Len Schaper, Aicha Elshabini, University of Arkansas

3:15 Break

3:45 Thick-Film Printable Polymer Insulator Paste: Development, Testing and Results
K. I. Arshak, D. P. Egan, University of Limerick

4:10 Structural Optimization for Ultra Fine Pad Pitch LDI Devices
Jin-Hyuk Lee, Sa Yoon Kang, Dae-Woo Son, Kwan-Jai Lee, Se-Yong Oh, Samsung Electronics

4:35 Advanced Thick Film System for AIN Substrates
Y. L. Wang, A. F. Carroll, J. D. Smith, Y. Cho, R. J. Bacher, D. K. Anderson, J. C. Crumpton, C. R. S. Needes, DuPont Microcircuit Materials

5:00 Mixed-Metal, Low Loss Green Tape™ Systems for Military, Automotive and Wireless Applications
Daniel I. Amey, Michael A. Smith, Kenneth E. Souders, Timothy P. Mobley, Christopher R. S. Needes, DuPont Microcircuit Materials

THP3 - Room A205

Passive Integration in PWB, Thin Film and On Chip Technologies

Chairs: Dr. Robert Heistand II, AVX Corporation; Richard Charbonneau, StorageTek

2 pm - 5 pm

Passive component integration is a very active packaging development area to increase performance, increase system yields, miniaturize systems and reduce system costs. Presentations on three very different vehicles for passive integration will be presented. These include continuing developments from thin film technology and PWB embedded components/materials along with the new thrust in thin film integrated passives on active chip.

2:00 Embedded Passives Technology for PCBs: Materials, Design, and Process
Jiming Zhou, John D. Myers, Delphi Delco Electronics Systems; John J. Felten, DuPont i-Technologies

2:25 Composite Dielectric Laminate for Integrated Capacitors
Kirk Slenes, Erik Luther, Tuqiang Chen, TPL Inc.

2:50 Novel Structure of Integral Passives Substrate and High Frequency Characteristics
Utsumi Shigeru, Hirofumi Fujioka, Mitsubishi Electric Corporation

3:15 Break

3:45 High-Q RF Inductors Fabricated using WLP Redistribution Technology
Quan Tran, Qing Ma, Intel Corporation

4:10 High-Q RF Inductors on Low Resistivity Silicon through Wafer Post-Processing
G. Carchon, W. De Raedt, E. Beyne, IMEC-MCP/HDIP

4:35 Integrated Capacitors for Multichip Module Packaging Applications
Allen C. Keeney, A. Shaun Francomacaro, Richard L. Edwards, Harry K. Charles, Jr., Johns Hopkins University/APL

THP4 - Room A201

Novel Manufacturing Technology

Chairs: Nicole Cavanah, Rockwell International; David Virissimo, Hi-Q Materials, Inc.

2 pm - 5 pm

The pursuit for smaller, higher density and affordable assemblies increases the challenges for robust manufacturing. This session highlights techniques developed to achieve robust manufacturing and integrated testing processes with ever-increasing challenges facing microelectronics packaging and assembly. New manufacturing developments include die pick and place, wire bonding, area array assembly, RF modules and optoelectronic assemblies.

2:00 Die Place Pickup Tips
Kevin Blakelock, Motorola AIEG

2:25 System Considerations for Active Laser Trimming of Bluetooth Modules
Bruce Couch, Yun Chu, Joe Lento, GSI Lumonics

2:50 Ultrasonic Bonding: Understanding How Process Parameters determine the Strength of Au-Al Bonds
Michael Mayer, ESEC SA; Juerg Schwizer, ETH Zurich

3:15 Break

3:45 Yield Improvement Methodologies for Flip Chip Assemblies using Solder On Pad (SOP) Substrates
Sarathy Rajagopalan, Mukul Joshi, Kishor Desai, LSI Logic Corp.

4:10 Implementation of Integrated Packaging of DC/DC Converter and PFC IPEMs using Bumpless Interconnected Embedded Chip Technology
Zhenxian Liang, J. D. Van Wyk, Fred C. Lee, Virginia Tech

4:35 Optical Leak Testing of Hermetic Semiconductor, MEMS and Optoelectronic Devices
John Newman, Steve Thayer, NorCom Systems Inc.

THP5 - Room A202/204

Reliability

Chairs: James T. Cook, Microelectronic Business Associates; Greg Caswell, Xetel Corporation

2 pm - 5:25 pm

The papers in this session focus on the design and reliability of interconnect materials and processes. Specific interest will be SMT and Flip Chip interconnect reliability concerns. The targeted audience for this session are for packaging, reliability and process engineers and technicians.

2:00 Impact of Under Bump Metallurgy on Solder Joint Reliability of Flip Chip on Low Temperature Co-Fired Ceramic Substrate
N. Duan, J. Scheer, J. Bielen, M. van Kleef, Philips Centre for Industrial Technology

2:25 Effect of Al Pad Surface Morphology on the Flip-Chip Solder Bump Reliability
Esther W.C. Yau, Simon P.C. Law, J. Z. Wei, Philip C. H. Chan, Hong Kong University of Science and Technology

2:50 Electromigration in WLCSP Solder Bumps
Glenn A. Rinne, Krishna K. Nair, Julia Roe, Unitive, Inc.

3:15 Break

3:45 Materials Characterization of the Effect of Mechanical Bending on Area Array Package Interconnects
Daniel T. Rooney, N. Todd Castello, Mike Cibulsky, Doug Abbott, Dongji Xie, Flextronics Inc.

4:10 Material Set Comparison in Moisture Sensitivity Classification of Nonhermetic Organic Packages
William R. Schildgen, Cameron T. Murray, 3M Company

4:35 A Case Study in Test Vehicle Design for Real-Time Reliability Characterization
Dennis Krizman, Scott Waters, Alex Chen, Celestica International Inc.

5:00 Solder Joint Reliability Testing of Back-to-Back Assembled BGA Components
Joyce E. S. Taylor, David W. Peters, Hewlett-Packard Company

THP6

Interactive Forum (Poster Session)

1 PM – 4 PM

Evaluation of Two Novel Lead-Free Surface Finishes
Richard Ludwig, Ning-Cheng Lee, Indium Corporation of America; Chonglun Fan, Yun Zhang, Lucent Technology

Improved Long-Term Stability of Solder Joints through Rapid Reflowing
Fritz Herbert, Lutz Dorn, Technical University Berlin

Beyond Periodic Pulse Reverse
Enrique Gutierrez Jr., TecNu, Inc.

WASPP Program: Advanced Passivation and near Hermetic Seals for Advanced Packages and Harsh Environments
Charles Reusnow, Lockheed Martin Missiles and Fire Control

Thermal Properties of New Composites of Diamond and Copper
Katsuhito Yoshida, Hideaki Morigami, Takahiro Awaji, Tetsuo Nakai, Sumitomo Electric Industries, Ltd.

Technical Challenges of Stencil Printing Technology for Ultra Fine Pitch Flip Chip Bumping
Dionysios Manessis, Rainer Patzelt, Sabine Nieland, Technical University of Berlin; Andreas Ostmann, Rolf Aschenbrenner, Herbert Reichl, Fraunhofer Institute for Reliability and Microintegration - IZM

Challenge of Flip Chip Encapsulation Technologies
Kevin Chai, Eddy Wu, Roger Hsieh, J. Y. Tong, Siliconware Precision Industries Co., Ltd.

Flip-Chip Packaging Solution for CMOS Image Sensor Device
Jong-heon Kim, In-Soo Kang, Sung-O Oh, Hak-Nam Kim, Esdy Baek, C-Cube Digital Corp., Ltd.; Tae-Jun Seo, Samsung Electro-Mechanics

Electroplated Micro-inductors and Micro-transformers for Wireless Applications
Jae Y. Park, Jong U. Bu, LG Electronics Institute of Technology

Structures of Cantilever with Implanted Strain Gauge
M. Husak, P. Kulha, J. Jakovenko, Czech Technical University of Prague; Z. Vyborny, Academy of Sciences of the Czech Republic

High-Resolution Integration of Passives using Micro-Contact Printing (mCP)
Charles D. E. Lakeman, Patrick F. Fleig, TPL Inc.

Investigations of the Effects of g-Radiation on the Optical and Electrical Properties of Nickel Phthalocyanine (NiPc) Thick Film
A. Arshak, S. M. Zleetni, K. Arshak, J. Harris, University of Limerick

High Dose Optical and Electrical Sensor Dosimeter using Cobalt Phthalocyanine (CoPc) Thick Film
A. Arshak, S. M. Zleetni, K. Arshak, J. Harris, University of Limerick

Prediction of Shrinkage and Deformation during LTCC Device Production
Aravind Mohanram, Gary L. Messing, David J. Green, Clive A. Randall, Pennsylvania State University

An Experimental Study of the Thermal Performance of Heat Pipe Embedded Cold Plate for Satellite Electronic Cooling
David B. Sarraf, Thermacore International, Inc.; Devarakonda Angirasa, NASA Glenn Research Center

New Microcontact for Separable, Reusable, High Digital Speed Level-2 Interconnections
Dariusz R. Pryputniewicz, Dimitry G. Grabbe, Ryszard J. Pryputniewicz, Worcester Polytechnic Institute

Direct Printing of Low Temperature Conductors for HDI, Displays, and other Fine-Feature Systems
Christopher Wargo, Yvonne Kunz, David Richard, Parelec Inc.

Patternable Compliant Silicones for Advanced Packaging Applications
Lyndon J. Larson, James S. Alger, Stanton J. Dent, Geoffery B. Gardner, Brian R. Harkness, Robert T. Nelson, Dow Corning Corporation

A Study of the Conduction Mechanisms of Screen-Printed Thick Films of MnZn Ferrite
K. Arshak, K. Twomey, University of Limerick

Biomedical Sensors: New Application Horizons? - A Review
Gabor Harsanyi, Budapest University of Technology and Economics

Friday, September 6

FA1 - Room A209
High Density Packaging

Chairs: R. Wayne Johnson, Auburn University; Scott Popelar, IC Interconnect

8 am - 11 am

Several innovations in high density packaging technologies including fine pitch packages and their assemblies, surface mount and flip-chip technologies will be presented.

8:00 High Density Stacked Packaging Solution for SiP Applications
Vern Solberg, Tessera Technologies, Inc.

8:25 Design and Reliability Study for Flip Chip Applications on Ultra-Thin Flexible Substrates using NanoPierce Connection System Technology
B. Zou, M. Kober, F. Blum, S. Mieslinger, L. Gaherty, W. Steinberg, B.Bahn, M. Wernle, H. Neuhaus, NanoPierce Technologies, Inc.

8:50 Wirebondability of Electroless Ni/Au Plated MCM Substrates
Jaydutt Joshi, Seth Greiner, Conexant Systems, Inc.

9:15 Break

9:45 Design and Reliability Study of High-Density mZ™-Ball Stack Technology
Ilyas Mohammed, Young-Gon Kim, Tessera Technologies, Inc.

10:10 Reliability of the 1st Level and the 2nd Level Inteconnections on the Flip Chip PBGA Package
Eun-Chul Ahn, Young-Min Lee, Ju-Hyun Ryu, Tae-Gyeong Chung, Se-Yong Oh, Samsung Electronics Co., Ltd.

10:35 Reliability Challenges of Flip Chip on Organic Substrate
Tae-je Cho, Eun-Chul Ahn, Jong-Bo Shim, Ho-Joong Moon, Se-Yong Oh, Samsung Electronics Co.

FA2 - Room A207
Thick Film II

Chair: Paul Galletta, Teledyne Electronic Technologies

8 am - 10:35 am

Thick film and thin technology are the base line building blocks for most of the microelectronic devices in existence today. This session will highlight the newer aspects of these technologies and how they can support your needs from D/C to light. These technologies have reinvented themselves to support a whole new series of product lines that meet both the cost and performance needs of those products. Please join us in a lively session that will explore new approaches for this 25-plus year old technology.

8:00 Simulation, Characterization and Design of Embedded Resistors in LTCC for High Frequency Applications
Gangqiang Wang, Fred D. Barlow, Aicha Elshabini, University of Arkansas (HiDEC)

8:25 Experiences in Obtaining Cross Belt Uniformity of ±1°C in a 24 inch Wide Thick Film Conveyor Furnace
Fred Dimock, BTU International

8:50 Copper Electroplating for Thick-Film Power Applications: A Successful Laboratory Method for Prototyping
K. I. Arshak, D. P. Egan, University of Limerick

9:15 Break

9:45 Insertion Loss of A6 LTCC System up to 40 GHz
Liang Chai, Aziz Shaikh, Vern Stygar, Ferro Electronic Material Systems; Reinhard Kulke, IMST GmbH

10:10 A Study of Microwave Behavior of a Thin-Print Gold Ink
David J. Nabatian, KOARTAN Microelectronic Interconnect Materials; Chuck Rosenwald, ARTEK Corporation; F. Barlow, H. Kabir, University of Arkansas

FA3 - Room A205
Thermal Mechanical and Electrical Modeling
Chair: Li Zhang, National Semiconductor Corp.

8 am - 11:25 am

Electrical and thermo-mechanical modeling has increasingly become an integral part of robust package design and cost reduction. This session covers papers on CFD simulation of electronic equipment with radiation and convection effects, thermo-mechanical modeling of RF power sensor systems, thermal compact models for IC packages, and electrical simulation for wideband applications, modeling of structures with embedded passives for RFIC applications, and 3D electromagnetic modeling of optoelectronic transceivers.

8:00 Linearized Superposition using CFD for Thermal and Power Characterization of Electronic Equipment with Significant Thermal Radiation and Natural Convection
Paul Gauché, Flomerics Inc.; Wen Wei, Intel Corporation

8:25 Thermo-Mechanical Simulation and Modeling of RF Power Sensor Microsystem
Jiri Jakovenko, Miroslav Husak, Czech Technical University; Tibor Lalinsky, Slovak Academy of Sciences

8:50 Modeling of Return Loss on Multilayer Package for Wideband Applications
Nansen Chen, Kevin Chiang, Y. P. Wang, Siliconware Precision Industries Co., Ltd; Yeong-Lin Lai, National Changhua University of Education

9:15 Break

9:45 New Configurations for High Frequency Capacitors and Composite Structures for Embedded Passive and RFIC Applications
Kala Gururajan, Harish Peddibhotla, Raghu K. Settaluri, Oregon State University

10:10 Analysis of PCB Power/Ground Plane Decoupling with New Solver Technology
Richard Remski, Ansoft Corporation

10:35 3D Electromagnetic Simulation of Optoelectronic Transceiver Structures
John C. Schultz, Gordon Henson, 3M Company; Robert Trammel, Marek Turowski, CFD Research Corporation (CFDRC)

11:00 The Extraction of a Two-Resistor/Two-Capacitor Model for Common IC Packages and their Implementation in CFD
David W. Stiver, Sarang Shidore, Flomerics Inc.

FA4 - Room A201
Optoelectronics
Chairs: Phil Zulueta, JPL; Ephraim Suhir, Iolon, Inc.

8 am - 11 am

As the Photonics/Optoelectronics industry continues to experience growth fluctuations, the attempt to find reliable, low cost methods of assembling optoelectronics remains a primary focus among researchers, technologists and package-developers. This session in Photonics/Optoelectronics Packaging reflects this theme as it addresses work, ranging from novel adhesive and process technologies for fiber alignment and VCSEL assemblies to the development of new glasses for planar, optical waveguides.

8:00 Characterization of Adhesives for Low Temperature Microelectronics and Photonics Packaging
C. Taylor, H. Naseem, W. Brown, University of Arkansas

8:25 Adhesive Assembly for Optoelectronic Transceivers
John Schultz, Glen Connell, Gordon Henson, Ron Davis, 3M Company

8:50 "Curing" Low Yields in Photonics
Richard S. Garard, Lambda Technologies, Inc.

9:15 Break

9:45 An O/E Measurement Probe Based on an Optics-Extended MCM-D Motherboard Technology
Herbert DePauw, J. De Baets, J. Vanfleteren, A. Van Calster, Ghent University (ELIS-TFCG) / IMEC

10:10 An Optimized System Level Design Methodology for an Opto-electronic Transceiver Module
Winfred Morris, Abdolreza Langari, Mindspeed Technologies™

10:35 Planar Optical Waveguides Fabricated by Ion-Exchange of Transition Metal Ions in Commercial and Special Optical Glasses
Jarmila Spirkova, Pavlina Nebolova, Pavla Nekvindova, Martin Mika, Institute of Chemical Technology; Anna Mackova, Karel Mach, Czech Academy of Sciences; Josef Schrofel, Czech Technical University

Special Session*

FA5 - Room A202/204
National Science Foundation & Sidney J. Stein Educational Foundation
Chairs: Rao Tummala, Leyla Conrad, Georgia Institute of Technology

8 am - 10:25 am

***Presentations will be 20 minutes each.**

Authors are NSF/SJS 2001-2002 Award Recipients

8:00 DC Resistivity Profile of Multilayer Dielectric Devices for Production Process Improvement
Aaron E. Hydrick, Alfred University

8:20 Surface Preparation of AlN Substrates for Metallization
Robert Campman, The New York State College of Ceramics at Alfred University

8:40 Fabrication of a Pressure Utilizing Low Temperature Co-fired Ceramics
Yasmin Morales, Boise State University

9:15 Break

9:45 Finite Difference Time Domain Simulation of Multiport Networks using S-Parameter Macromodels for Packaging Applications
Chris Lasek, University of Colorado at Boulder

10:05 Chip-Package Co-design of RF Microsystems
Leroy Griffith, Rochester Institute of Technology

A Warm Western Welcome TO EXHIBITORS

As Exhibit Co-Chair for the IMAPS 2002 Denver International Symposium, I am pleased to **WELCOME the EXHIBITORS** to Denver, CO. The IMAPS 2002 Committee would like to express our thanks for your company's participation in the 2002 IMAPS Symposium as we are aware of the stressful economic business conditions and the financial commitment required to attend the symposium. We believe that this exhibit will be a great sales and marketing opportunity for your company nationally, internationally and locally in the Rocky Mountain area as well.

The Colorado Convention Center is a world-class exhibitor facility with a great show booth layout with easy access to and from the technical sessions. Several events are scheduled to bring attendees to the show floor, as an aid to maximizing traffic through the exhibit area.

Another new addition for the exhibitors will be an Exhibitors Lounge for your personal and private business times. The front range of Colorado is home to a multitude of high tech companies that employ microelectronics packaging in their telecommunication and photonics products. This is an exceptional opportunity to reach these companies with your cutting-edge technologies.

Again, Thanks for participating in the IMAPS 2002 International Symposium!

Warner Andrews
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IMAPS 2002 Exhibit Co-Chair

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Horsham, PA 19044
Ph: 215-328-0700
Fax: 215-328-9410
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Web Address: www.ssecusa.com

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Nashua, NH 03062-2801
Ph: 603-891-9186
Fax: 603-891-0597

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Fax: 703-440-9512
E-Mail: info@sonix.com
Web Address: www.sonix.com

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Elk Grove Village, IL 60007-5914
Ph: 847-437-6400
Fax: 847-437-1550
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205 LaGrange Avenue
Rochester, NY 14613
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Fax: 716-254-4614
E-Mail: bcapar@metrocircuits.com
Web Address:
www.metrocircuits.com

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SST International
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9801 Everest Street
Downey, CA 90242
Ph: 562-803-3361
Fax: 562-803-4034
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pbarnes@sstinternational.com
Web Address:
www.sstinternational.com

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(The) Strouse Corporation
Booth #: 923
1130 Business Parkway South
Westminster, MD 21157
Ph: 410-848-1611
Fax: 410-848-9220
E-Mail: schambers@strouse.com
Web address: www.strouse.com

Suss MicroTec (formerly Karl Suss America)
Booth #: 838
228 Suss Drive, Route 100
Waterbury Center, VT 05677
Ph: 802-244-5181
Fax: 802-244-5103
E-Mail: info@suss.com
Web Address: www.suss.com

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Orlando, FL 32807
Ph: 407-678-6900
Fax: 407-678-0578
E-Mail: wetest@sypris.com
Web Address: www.sypris.com

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66 W. Springer Drive, #314
Highlands Ranch, CO 80129
Ph: 303-471-0999
Fax: 303-471-1104
E-Mail: plating@tecnu.net
Web Address: www.tecnu.com

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Teledyne Interconnect
Booth #: 220
3565 Corporate Court
San Diego, CA 92123
Ph: 858-576-1005
Fax: 858-576-0607
E-Mail:
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Web Address:
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Web Address:
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Booth #: 107
#401 Youngdo Capital Rd.
218-1 Oksu-dong,Sungdong-Gu
Seoul, 133-839
Korea
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Fax: 82-3395-2173
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Thin Film Technology
Booth #: 502
153 Industrial Way
P.O. Box 1942
Buellton, CA 93427
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tives@thinfilmtechnology.com
Web Address:
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Toth Technologies
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511 Union Ave.
Delanco, NJ 08075
Ph: 856-662-8700
Fax: 856-662-7475
E-Mail: tedjr@tothtech.com
Web Address: www.tothtech.com

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Booth #: 320
5105 Maureen Lane
Moorpark, CA 93021
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Fax: 805-523-1061
E-Mail: sales@ultronsystems.com
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San Clemente, CA 92673
Ph: 949-361-9999
Fax: 949-361-9998
E-Mail: conrad@unichemind.com
Web Address: www.unichemind.com

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Unitek Benchmark
Booth #: 309, 311
555 Straw Hill
Manchester, NH 03104
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Napa, CA 94558
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Web Address: www.visioneng.com

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1551 Gene Autry Way
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San Jose, CA 95131
Ph: 408-954-8353
Fax: 408-954-8369
E-Mail: jreynoldsyes@aol.com
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Student Booths*

Florida International University
Miami, FL
Student Advisor: Dr. W. Kinzy Jones
jones@eng.fiu.edu

Northern Illinois University
DeKalb, IL
Student Advisor: Dr. Alan P. Genis
Genis@ceet.niu.edu

South Dakota State University
Brookings, SD
Student Advisor: Dr. David W. Galipeau
david_galipead@sdstate.edu

University of Arkansas/HiDEC
Fayetteville, AR
Student Advisor: Dr. Aicha Elshabini
aicha@engr.uark.edu

***Student Booth locations and additional Student entries are listed on the Addendum inserted in this Final Program.**

Hotel Information

Adam's Mark Hotel*

1550 Court Place
Denver, CO 80202
Phone: 303-893-333
Fax: 303-626-2542
www.adamsmark.com/denver/index.asp

Comfort Inn Downtown

401 17th Street
Denver, CO 80202
Phone: 303-296-0400
Fax: 303-312-5941

*Headquarters Hotel. Located 6 blocks from the Colorado Convention Center. Site of the IMAPS Welcome Reception.

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Unitek Benchmark 309, 311
Vision Engineering, Inc. 403
West-Bond 839, 841, 843
Yield Engineering Systems, Inc. 603

program AT A GLANCE

Tuesday September 3

8 AM - 4 PM
Registration Open

6:45 AM - 4 PM
Golf Tournament

9 AM - 5 PM
Professional Development Courses (T1 - T10) CCC

5 PM - 6 PM
PDC Reception

6:30 PM - 8 PM
Welcome Reception
(at the Adam's Mark Hotel)

Wednesday September 4

7 AM - 6 PM
Registration Open

8 AM - 11 AM
Technical Sessions (WA3, WA5)

8 AM - 11:25 AM
Technical Sessions (WA1, WA2, WA4)

9 AM - 6:30 PM
Employment Center

10 AM - 4 PM
Spouse/Guest Program

9 AM - 11 AM
Student Booth Judging

9 AM - 6 PM
Exhibits Open

11:40 AM - 12:15 PM
Awards Ceremony
(Exhibit Hall A)

12:15 PM - 2:30 PM
Lunch in the Exhibit Hall A

1:45 PM - 2 PM
Annual Business Meeting
(Exhibit Hall A)

2:30 PM - 3:15 PM
Press Conferene

2:30 PM - 5:30 PM
Technical Sessions (WP1-WP5)

3 PM - 4:30 PM
Student/Industry Panel

4:30 PM - 5:30 PM
Student/Industry Reception

Thursday September 5

7 AM - 5 PM
Registration Open

8 AM - 10:35 AM
Technical Session (THA3)

8 AM - 11 AM
Technical Sessions (THA1, THA2, THA4)

8 AM - 11:25 AM
Technical Session (THA5)

8 AM - 11:30 AM
Student Plant Tour

9 AM - 5 PM
Exhibits Open

9 AM - 5 PM
Spouse/Guest Program

9 AM - 5:30 PM
Employment Center

1 PM - 4 PM
Interactive Forum/Poster Session (THP6)

2 PM - 4:35 PM
Technical Session (THP1)

2 PM - 5 PM
Technical Sessions (THP3, THP4)

2 PM - 5:25 PM
Technical Sessions (THP2, THP5)

Friday September 6

7 AM - NOON
Registration Open

8 AM - 10:25 AM
Special Session (FA5)
NSF & SJS Educational Foundation

8 AM - 10:35 AM
Technical Session (FA2)

8 AM - 11 AM
Technical Sessions (FA1, FA4)

8 AM - 11:25 AM
Technical Session (FA3)

8 AM - 12:30 PM
Employment Center

9 AM - NOON
Exhibits Open

Professional Development Courses (F1 - F9) will be held at the Adam's Mark Hotel Noon – 6 pm Lunch at 11 AM Plaza Ballroom A
(*PDC Attendees/Instructors ONLY*)

Noon - 6 PM
Professional Development Courses (F1 - F6)

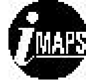
Noon - 3 PM
Professional Development Course (F7)

Noon - 3 PM
Professional Development Course (F9) - ***FOR STUDENTS ONLY!***

3 PM - 6 PM
Professional Development Course (F8)

Exhibit Hall Map

Call for Papers - IMAPS 2003



36th International Symposium on Microelectronics
Hynes Convention Center, Boston, MA • November 18-20, 2003

The 36th International Symposium on Microelectronics will be held at the Hynes Convention Center, Boston, MA. It is sponsored by the International Microelectronics And Packaging Society (IMAPS). The IMAPS Technical Committee seeks original papers that demonstrate how new technologies and applications are expanding and redefining the international role of microelectronics. All abstracts submitted must represent original, previously unpublished work.

General Chair: **Delip "Doug" Bokil**
delipbokil@yahoo.com

Technical Program Chair: **Ken Gilleo**, Cookson Electronics
kgilleo@cps.cookson.com

Abstract Cut-off Date: March 14, 2003
Notice of Acceptance: April 14, 2003
Final Manuscripts Due: July 25, 2003

Papers are being sought from, but not limited to, the following subjects:

Advanced Materials & Processes
Advanced Substrate Technology
Area Array Assembly
Automotive Electronics
Chip-Scale Packaging/Flip Chip
High Density Displays
High Density Packaging
Low Cost Packaging Methods
Management & Marketing
Manufacturing Technologies
Medical Electronics
MEMS Packaging and Applications
Modeling & Simulation
Novel Interconnections
Optoelectronics/Photonics
Polymer Materials & Applications
Power Packaging/Thermal Management
Printed Wiring and Flex Boards
Quality & Reliability
RF/Microwave — Wireless
Sensor Packaging & Applications
Space & Military Electronics
Statistical Process Control Methods
Surface Mount Technology
Thick & Thin Film Materials
Wafer Scale Packaging

Cash Awards Offered

To reward exceptional work, IMAPS offers awards based on technical content, originality and applicability to current issues. Awards are presented in the following areas:

Best Paper of the Symposium Award
Cash Award

IMAPS offers a cash award of $2000 for the Best Paper of the Symposium. The IMAPS Technical Committee chooses the Best Paper based upon evaluations submitted by the members of the Technical Subcommittees and the Symposium Session Chairs.

Outstanding Paper Award
Cash Award

IMAPS offers a cash award of $500 each for two (2) papers designated as Outstanding Papers of the Symposium. The IMAPS Technical Committee chooses the two (2) Outstanding Papers based upon evaluations submitted by the members of the Technical Subcommittees and the Symposium Session Chairs.

Best Paper of Session

These awards are based on technical quality and originality of written manuscripts. Only the Best of Session papers are considered for Best Paper of the Symposium and Outstanding Paper awards.

Please send your 250-300 word abstract **electronically only** by March 14, 2003, using the On-line submittal form at:
www.imaps.org/abstracts.htm
If you are having problems with the on-line submittal form,
please email Jackki Morris-Joyner jmorris@imaps.org or call 305-382-8433.

IMAPS Topical Workshop & Exhibition on
Optoelectronics Packaging and Micro-Optoelectromechanical Systems (MOEMS)

Radisson Hotel Bethlehem
Bethlehem, PA
October 8-11, 2002

Sponsored by:
International Microelectronics And Packaging Society (IMAPS)
and the Local IMAPS Keystone Chapter

General Chair: **Thomas Green,** National Training Center for Microelectronics
tgreen@northampton.edu

Technical Chair: **Rajeshuni Ramesham,** Jet Propulsion Laboratory
Rajeshuni.Ramesham@jpl.nasa.gov

Building on the success of last year's Advanced Technology Workshop (ATW) on "Optoelectronics Packaging," an expanded venue is planned for this year including an afternoon of vendor exhibits and Professional Development Courses (PDCs). This IMAPS topical workshop will focus on recent advances in optoelectronics, packaging of optoelectronic devices and associated technologies including a special session on MOEMS. An outstanding program is planned with internationally recognized speakers from industry, academia and government.

View the program and register on-line at www.imaps.org/programs/opto2002.htm

Advanced Technology Workshop on
Thermal Management for High Performance Computing and Wireless Applications

Sheraton Palo Alto Hotel
Palo Alto, California USA
October 24-26, 2002

Sponsored by:
International Microelectronics And Packaging Society (IMAPS)

General Chair:
Dave Saums
Ceramics Processing Systems Corporation
Newburyport, MA USA
dsaums@msn.com

The 2002 ATW will be focused on high-performance applications in computing (server, enterprise server, workstation, desktop, and mobile/handheld systems) and wireless/RF systems. This Workshop is intended to provide a forum for concise and detailed technical communication of concepts for design, analysis, characterization, and application of such proposed or implemented solutions at the component level and for examination of overall system packaging technologies. An additional session on Refrigeration and Alternative Thermal Systems has been added for the 2002 ATW.

Visit www.imaps.org for more information.

Downtown Map (Hotels)