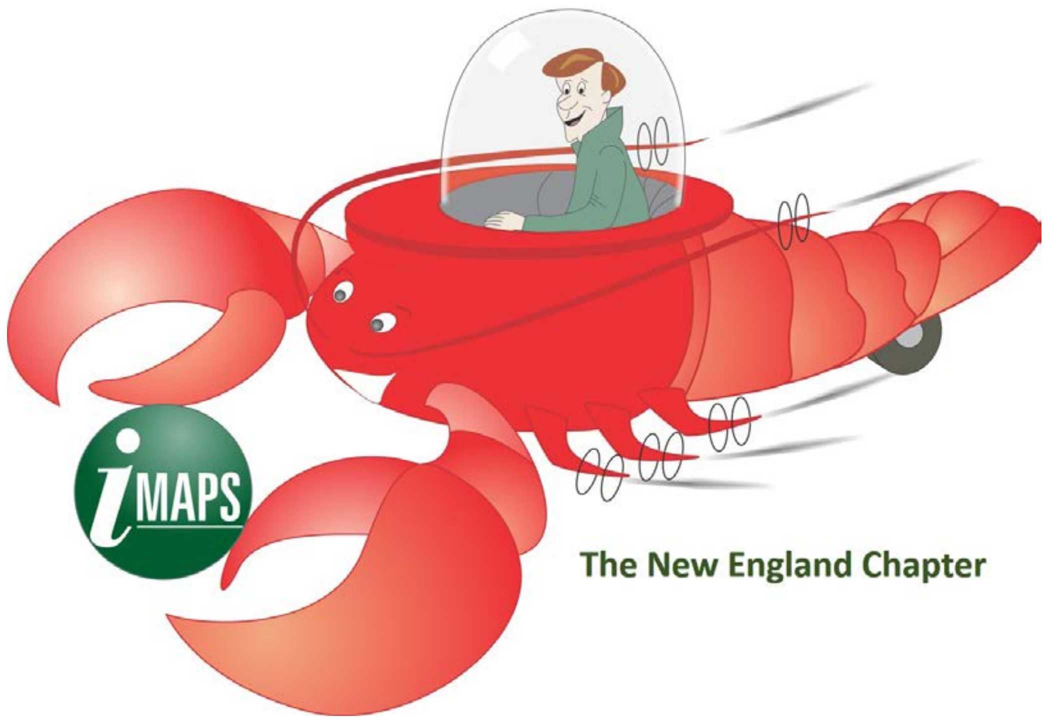
iMAPS New England 44th

Symposium & Expo

Technical Program

Tuesday May 2nd 2017

Boxboro Regency Hotel
Boxborough, MA



The Jetsons® 2017

Jon Medernach

IMAPS NE
Chapter President

Dr. Parshant Kumar
& Dmitry Marchenko

IMAPS NE
Symposium Technical Chairs

Welcome to iMAPS New England May 2nd, 2017

iMAPS Mission Statement

iMAPS leads the Microelectronics Packaging, Interconnect and Assembly Community, providing means of communicating, educating and interacting at all levels.

Welcome to the 44th Annual iMAPS New England Symposium and Expo! This event is our effort to support the mission of the International Microelectronics Assembly and Packaging Society. Through the dedicated efforts of our volunteer staff we have put together a program that we feel reflects the current interest of our members and the ever evolving microelectronics industry. This year's event features presentations in RF and Microwave Technologies and Thermal Management as well as Nano electronics and Optoelectronic, Medical Device Packaging and Printed Electronics.

With the growing interest in sensor technology and the advances in optoelectronics, MEMS devices and nanomaterials we are witnessing exciting times. The use of these technologies to improve our everyday life is evident every time we drive a car or use a cell phone. We are currently just touching the surface of additive technologies that allow the printing of electronics and eliminating circuit boards and traditional packages altogether. We must wonder, where will it lead us?

We have an outstanding technical program thanks to the efforts of our Technical Chairman, Parshant Kumar of Draper with the help of Dmitry Marchenko of BAE as well as a host of session chairs. Many thanks for their effort in putting together this fantastic program! I should mention this is the largest regional event within iMAPS and is entirely volunteer run.

Creativity is thinking about new things, innovation is doing new things. We hope that our efforts help to inspire creativity and innovation through education and networking with fellow members. Please take advantage of the technical offerings as well as the exposition to learn about new services, materials and equipment. This event would not be possible without the support of the exhibitors that represent all levels of the microelectronics supply chain. Please be sure to visit the exhibits and make a special effort to recognize our Gold and Silver Sponsors for their contribution to the Society.

The expo itself is an enormous undertaking and would not be possible without the efforts of our Executive Committee. Thanks to John B, Mike G, Harvey, Minh, Joe, Tom, Jeremy, Michael T, Dmitry, John R, Jim, Amaresh, Rozalia and a special thanks to Judi for hard work and creativity. We sincerely hope you enjoy the event.

We will have the luncheon and keynote speaker in the Exhibit Hall to promote networking with the exhibitors and fellow attendees. We will have refreshments and entertainment in the Exhibit Hall in the afternoon along with a chance to win some outstanding prizes supplied by our exhibitors and the Society. Be sure to attend for some fun and a chance to win!

Thank you for your attendance, Enjoy the day!

Jon Medernach

iMAPS New England President

Symposium's Technical Chairs Welcome Letter

Dr. Parshant Kumar

We'd like to welcome everyone to the 44th Annual New England *i*MAPS Symposium! Thanks to all the Session Chairs we've compiled an engaging program of technical talks on many of today's hot topics that will peak the interest of every Attendee. We hope you take full advantage of the opportunity to interact with the speakers and each other in a learning environment that's only available at this unique one day symposium. Below is a brief summary to help you on your way and don't forget to spend time in the exhibit hall, because after all, without the support of the exhibitors, this day wouldn't be possible. Enjoy!!!

Dmitry Marchenko

Nanoelectronics & Optoelectronics Packaging: The session will include a presentation by MIT about grand challenges and timelines for electronic-photonic integration efforts. UMass Lowell will present their latest work on standoff chemical sensing wireless networks. Forward Photonics will discuss their quantum cascade laser power scaling developments. Packaging of Micro-Concentrating Photovoltaics is being presented by MIT. Analog Devices will discuss challenges in optical sensor module packaging - evolving from past into future, and MRSI will show case their discussion on the automated die bonding for high volume Optoelectronics manufacturing.

MEMS & Nano Systems: This session covers the latest advancements in MEMS and Nano System packaging. Draper's latest development on Miniature Multiwire Systems will be discussed on rapid prototyping of new designs. Flex's new manufacturing process for Fabricating 3D Interconnects for MEMS and ICs will be a really hard to miss talk. Sensata's development on MEMS packaging for reliable, low pressure sensing in automotive applications is really worth looking at. A Draper talk will elaborate on low temperature, hermetic packaging of a MEMS electric field sensor The work on advanced integration program at BRIDG and the reliability issues will shed the light on packaging challenges in 2.5D/3D integration. Vesper MEMS talk discussing their latest development on tuning the resonance frequency of piezoelectric MEMS microphones by sizing acoustic ports will be a new insight in fine acoustic sensors.

RF & Microwave - Innovations and Emerging Technologies: This session is all about the technologies that are driving the RF and microwave packaging industry. HXI will discuss their latest work on the microwave and millimeter wave multichip module manufacturing. Agile will explain more on the challenges of microwave assembly. Computer Simulation technologies will demonstrate work on multifaceted simulation for the design of a smartwatch. BAE Systems will discuss their work on the detection of contamination in microwave and RF electronics. Meino Micro will elaborate on hermetic system-in-package for high power RF switches, and Communications & Power Industries will be talking about device physics matters in RF & microwave design.

Medical Device Packaging: Miniaturized medical electronics is becoming more and more widespread. To learn more about unique challenges of packaging medical devices, please attend this session. MST will detail embedding of active components in LCP for implantable devices and MIT/Draper explores Low-cost electronically controlled prostheses for transfemoral amputees. AEMtek will discuss the use of advanced microelectronic packaging techniques to miniaturize implantable neuro stimulators, WPI will talk about TMD based nanocomposites, and Draper's work on the Dragonfleye - ultraminiature cybernetic insect control using optogenetics will be presented. Tufts University will reveal their work on thread based sensors and interconnects for medical diagnostics. This session is too good to miss!

Thermal Management: This session provides an opportunity to learn, understand, and interact with the folks who bring the thermal management for advanced packaging in microelectronics. Materion will discuss their work on automation of die attach of Si on Cu which is still evolving. DS&A will present an overview of thermal Issues for handheld, mobile, and medical implantable devices and Laird Technologies will discuss thermal & EMI solutions for mobile devices. Berliner Nanotest will show their work on a test chip for thermal characterization and qualification of materials, packages and systems. Kuprion, a spin off from Raytheon, will discuss their latest development on improved heat dissipation for high-power systems via nanocopper-based metal SMT, followed by an interesting talk on traditional electronic coolants and rack mount vapor cycle chillers by K-O concepts.

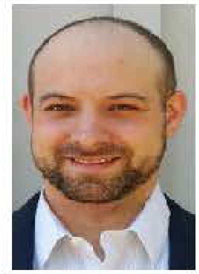
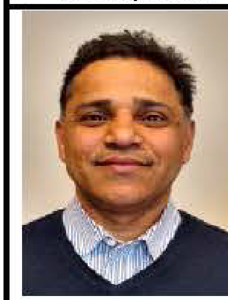
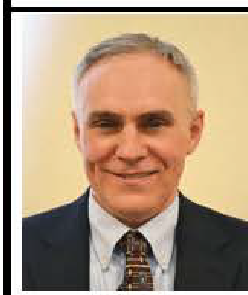
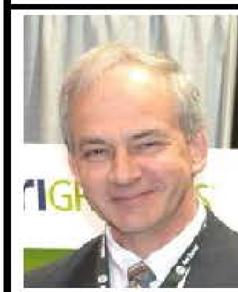
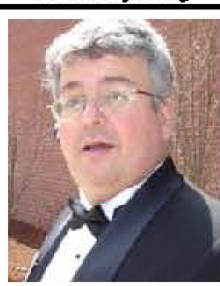
Printed Electronics: This session is a set of printing methods used to create electrical devices on various substrates. This disruptive technology is being adopted by many different industries, with strong leaders right in our region. The session includes a presentation by Flex Boston Innovation Center on printing 2D and 3D nanostructures for electronics and sensors. Dow Electronic Materials will cover inkjet printable etching and plating resists. Optomec will present their latest work on the 3d printing of flexible and stretchable interconnects. ANSYS will discuss their work on 3D printed antennas for RF energy harvesting. Wrapping up this session will be the MIT Nano Center introduction where the cleanroom technology makes all these devices possible.

Poster Session: This year the competition in the poster session is really heating up. $500 dollars to the first place winner! The posters will be covering micro coax for power distribution, design of drone delivery containers for vaccine distribution, optimizing longitudinal-fin heat sink designs, and verifying electronic component cleanliness using Ion Chromatography! Tufts will be presenting Packaging with Microfluidic Eutectic Metal Interconnects The students and experts are our future, so please set aside some time to go and talk with each of them to learn what's new on the horizon.

Kind Regards, Dr. Parshant Kumar Dmitry Marchenko

2017 *i*MAPS New England Symposium Technical Chairs

IMAPS New England Executive Committee 2017-2018

 **Jon Medernach** President *MRSI Systems*	 **Dmitry Marchenko** Vice President *BAE Systems*	 **Minh Tran** Treasurer *Mini-Systems*	 **Dr. John Blum** 1st Past President *Triton Systems*	 **Matt Bracy** Registration *MSD Sales*
 **Harvey Smith** * Publicity *EMA Sales*	 **Judi Eicher** Arrangements *EMA Sales*	 **Parshant Kumar** Symp Tech Chair *Draper*	 **Rozalia Beica** Tech Meetings *Dow Chemical*	 **Michael Toro** Exhibitor Chair *Ametek*
 **Jeremy Lug** Membership *Metrigraphics*	 **Mike Gervais** * Sponsorships *Geib Refining*	 **Amaresh Mahapatra** Education *Linden Photonics*	 **Joe Soucy** Photo/Proceedings *Draper*	 **Tom Marinis** * CD/Proceedings *Draper*
The New England Chapter * denotes Past Presidents	 **John Redman** * Sponsor Plaques *Superior Technical*	 **Jim McLenaghan** Board Member *Creyr Innovation*	 **Dr. Rita Monanty** * Past President *DfR Solutions*	The New England Chapter * denotes Past Presidents

Keynote Lunch Address

"From Interconnect to Innovation in the DoD"

Presented by Dr. Livia Racz

Assistant Leader of the Chemical, Microsystem & Nanoscale Technologies Group - Lincoln Laboratory - Massachusetts Institute of Technology, Lexington, MA

Email: livia.racz@ll.mit.edu

URL: https://www.ll.mit.edu/mission/electronics/cmnt/bios/racz-l.html

12:15 – 12:45 – Exhibit Hall

Keynote Abstract

In electronics packaging, as in all areas of electronics in the 20th century, the military used to set the pace for new developments, with major investments in facilities and strategic initiatives, and engineering innovation happening in large, captive semi-monopolies. This is no longer the common model for innovation. Additionally, there is instant and widespread dissemination of technological information all over the world. The aggregate result of these shifts is that we are no longer optimally equipped to apply the best technologies to problems of national security. This talk broadly examines some of the top unmet needs, reviews some of the approaches that are being used successfully to address the challenges, and focuses on the value added by truly innovative developments in Advanced Packaging and Microsystems Integration. An innovation framework is presented, which introduces rigor into value creation by integration, which goes beyond reduction of size, weight, and power. Case studies are selected and reviewed from the literature, and example research projects are highlighted that are currently in progress at MIT Lincoln Laboratory. These include a tiled, large-format imager, a 3D-integrated platform for quantum computing, and multimaterial fiber and textile devices.

Biography

Dr. Livia M. Racz is the Assistant Leader of the Chemical, Microsystem and Nanoscale Technologies Group, where she currently leads a major experimental effort in the physical realization of superconducting qubits. In addition to this activity, Dr. Racz has broader interests in materials engineering and microsystems integration, and she leads the Novel and Engineering Materials (NEMs) internal research and development technology portfolio for Lincoln Laboratory. Prior to joining the Laboratory, Dr. Racz held positions of increasing responsibility at the Charles Stark Draper Laboratory, including Technical Director and program manager of several programs in miniaturized electronic systems, leader of the Advanced Packaging Group, and leader of the Microsystems Technologies Division. She has more than 20 years of experience in developing new materials, processes, and integration schemes for miniaturized electronic systems. She has more than 50 publications, patents, and awards in these areas. She has worked at startup companies and has served on the faculty of Tufts University's Department of Mechanical Engineering. Dr. Racz received her SB and PhD degrees in materials science and engineering from MIT and was an Alexander von Humboldt Research Fellow at the Institute for Space Simulation in Cologne, Germany.

44th Annual Symposium - Tuesday May 2nd, 2017

Technical Program - Quick Guide

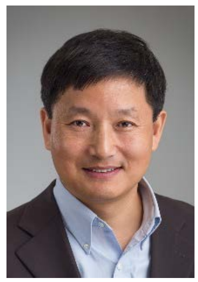
Session			Room	Chairs	# Papers
Sessions 8:30 – 11:30 AM					
Morning	A:	Nanoelectronics & Optoelectronics	Colonial	Yi Qian Jin Li	6
Morning	B:	MEMS & Nano Systems	Cotillion	Robert White Rick Morrison	6
Morning	C:	RF and Microwave - Innovations & Emerging Technologies	Seminar	Tom Terlizzi Chandra Gupta	6
Morning	G:	Posters (all day)	Exhibit Hall Presenters: 2:00 – 3:30 PM	Tom Marinis Amaresh Mahapatra	5 +
Lunch Break – Exhibit Hall – 11:45AM – 1:15PM					

Sessions 1:00 – 3:30 PM					
Afternoon	D:	Medical Device Packaging	Colonial	Caroline Bjune Steve LaFerriere	6
Afternoon	E:	Thermal Management	Cotillion	Dave Saums	6
Afternoon	F:	Printed Electronics	Seminar	Katherine Duncan Craig Armiento	5

Exhibit Hall Open 9:00AM – 4:30PM

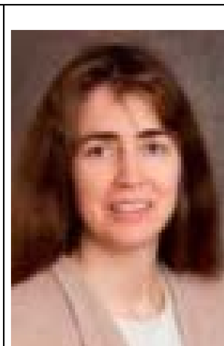
44th Annual Symposium - Tuesday May 2nd 2017

Morning Technical Program – Session Chairs

Session		Chair		Chair	
A:	**Nanoelectronics & Optoelectronics Packaging**	**Yi Qian** **MRSI Systems** 978-495-9742 yi.qian@mrsisystems.com		**Jin Li** **Sr. Product Manager** **Cambridge Technology** 781-266-5217 Jin.Li@cambridgetechnology.com	
B:	**MEMS & Nano Systems**	**Robert White** **Associate Prof. Mech Engineering** **Tufts University** 617-627-2210 r.white@tufts.edu		**Rick Morrison** **Engineering Mgr.** **Draper** 617-258-3420 rmorrison@draper.com	
C:	**RF and Microwave: Innovations & Emerging Technologies**	**Tom Terlizzi** **Vice President** **GM Systems LLC** 631-269-3820 terlizzi@gmsystems.com		**Chandra Gupta** **Communications & Power Industries, LLC** 516-807-9488 c.gupta@ieee.org	
G:	**Posters (all day)**	**Tom Marinis** **Technical Staff** **Draper** 617-258-3479 tmarinis@draper.com		**Amaresh Mahapatra** **President** **Linden Photonics, Inc.** 978-392-7985 am@lindenphotonics.com	

44th Annual Symposium - Tuesday May 2nd 2017

Afternoon Technical Program – Session Chairs

Session		Chair		Chair	
D:	**Medical Device Packaging**	**Caroline Bjune** **Product Development** **Draper** 617-258-2521 cbjune@draper.com		**Steve LaFerriere** **Dir. North Am. Business Devel.** **Yole Développement** 480-922-7164 laferriere@yole.fr	
E:	**Thermal Management**	**David Saums** **Principal** **DS&A LLC** 978-499-4990 dsaums@dsa-thermal.com			
F:	**Printed Electronics**	**Katherine J. Duncan** **Principal Investigator** **Printed RF Structures Group** 443-395-4401 Katherine.i.duncan8.civ@mail.mil		**Craig Armiento** **Professor** **Printed Electronics Research Collaborative (PERC)** **UMass Lowell** 978-934-3395 Craig_Armiento@uml.edu	

Morning Session	**Colonial Room**
8:30 – 11:30	**Session A: Nanoelectronics & Optoelectronics** **Yi Qian & Jin Li – Co-Chairs**
8:30	**"Grand Challenges and Timelines for Electronic-Photonic Integration", Lionel C. Kimerling** – Massachusetts Institute of Technology, Cambridge, MA
8:55	**"Standoff Chemical Sensing Wireless Network of Traditional and Aerosol Inkjet Printed Conductors under Tensile and Strain", Xuejun Lu –** University of Massachusetts Lowell, Lowell, MA
9:20	**"Quantum Cascade Laser Power Scaling Developments", Jeffrey Shattuck** - Forward Photonics, Wilmington, MA
9:45 – 10:15	**Coffee Break in the Exhibit Hall**
10:15	**"Wafer-level Integration and Packaging of Micro-Concentrating Photovoltaics", Juejun Hu**, Lan Li, Duanhui Li, Tian Gu – Massachusetts Institute of Technology, Cambridge, MA; Bradley Jared, Gordon Keeler, Bill Miller, William Sweatt, Scott Paap, Michael Saavedra, Charles Alford, John Mudrick, Anna Tauke-Pedretti - Sandia National Laboratories, Albuquerque, NM; Ujjwal Das, Steve Hegedus, - Institute of Energy Conversion, University of Delaware, Newark, DE
10:40	**"Challenges in Optical Sensor Module Packaging -Evolving from Past into Future", Julia Ying Zhao**, David Bolognia – Analog Devices, Inc., Wilmington, MA
11:05	**"Automated Die Bonding for High Volume Optoelectronics Manufacturing: Speed, Accuracy, and Flexibility", Peter Cronin -** MRSI Systems, Billerica MA
11:45 – 1:15	**Lunch & Keynote in the Exhibit Hall**

Afternoon Session	**Colonial Room**
1:00 – 3:30	**Session D: Medical Device Packaging** **Caroline Bjune & Steve LaFerriere – Co-Chairs**
1:00	**"Embedding of Active Components in LCP for Implantable Medical Devices", Susan Bagen** – MST [Micro Systems Technologies], Mesa, AZ 85210; Dr. Eckardt Bihler, Dr. Marc Hauer - Dyconex AG, Switzerland
1:25	**"Low-Cost Electronically-Controlled Prostheses for Transfemoral Amputees", Molly Berringer** – Draper / MIT, Cambridge, MA
1:50	**"The Use of Advanced Microelectronic Packaging Techniques to Miniaturize Implantable Neuro Stimulators", Jim Ohneck** – AEMtec/Exceet North America, Cleveland / Akron, OH
2:15	**"Chromatic Mechanical Response in 2-D Layered Transition Metal Dichalcogenide (TMDs) based Nanocomposites", Balaji Panchapakesan -** Worcester Polytechnic Institute, Worcester, MA
2:40	**"Dragonfleye - Ultraminiature Cybernetic Insect Control Using Optogenetics", Carlos Segura**, Jesse Wheeler, Joseph Register, John Le Blanc, Parshant Kumar, Dennis Callahan, Charles Lissandrello, Aaron Stoddard, Andrew Czarnecki, Christopher Salthouse, Alexander Oliva, – Draper, Cambridge, MA
3:05	**"Thread Based Sensors and Interconnects for Medical Diagnostics", Meera Punjiya** – Tufts University, Medford, MA
3:00 – 4:30	**Refreshments & Raffles in the Exhibit Hall**

Morning Session	Cotillion Room
8:30 – 11:30	**Session B: MEMS & Nano Systems** **Robert White & Rick Morrison – Co-Chairs**
8:30	**"Miniature Multiwire Systems (MMS)", Caprice Gray Haley**, Anthony Kopa, Andrew Magyar, Amy Duwel, Brian Smith, Sara Barron, Mitch Meinhold, and Seth Davis – Draper, Cambridge, MA
8:55	**"A New Manufacturing Process for Fabricating 3D Interconnects for MEMS and ICs", Cihan Yilmaz, PhD** - Flex Boston Innovation Center, Boston, MA
9:20	**"MEMS Packaging for Reliable, Low Pressure Sensing in Automotive Applications", Sam MacNaughton**, Matt Lasorsa, Giff Plume – Sensata Technologies, Attleboro, MA
9:45 – 10:15	**Coffee Break in the Exhibit Hall**
10:15	**"Low Temperature, Hermetic Packaging of a MEMS Electric Field Sensor", Douglas Gauthier,** Daniel Reilly, James Bickford, & Stephanie Golmon – Draper, Cambridge, MA
10:40	**"Advanced Integration Program at BRIDG and the Reliability Issues with 2.5D / 3D Integration", Amit Kumar**, John Allgair – BRIDG, Neocity, FL
11:05	**"Tuning the Resonance Frequency of Piezoelectric MEMS Microphones by Sizing Acoustic Ports", Yu Hui**, Jongsoo Choi, & Robert Littrell – Vesper MEMS, Boston, MA
11:45 – 1:15	**Lunch & Keynote in the Exhibit Hall**

Afternoon Session	Cotillion Room
1:00 – 3:30	**Session E: Thermal Management** **Dave Saums – Chair**
1:00	**"Automation of Die Attach of Si onto Cu using BondFlow™", Richard Koba,** Kent Hutchings **–** Materion, Tyngsboro, MA**;** Jim Fraivillig - Fraivillig Technologies, Boston, MA; Peter Cronin - MRSI Systems, North Billerica, MA
1:25	**"Market, Regulatory, Packaging, and Thermal Design Issues for Implantable Medical, Handheld, and Mobile Devices", David L. Saums** - DS&A LLC, Amesbury, MA
1:50	**"Efforts Toward a Board Level Holistic Thermal and EMI Solution for Mobile Electronic Devices", Eugene Pruss,** Jason Strader - Laird Technologies, Cleveland, OH
2:15	**"Thermal Test Chip for Thermal Characterization and Qualification of Materials and Semiconductor Packages", Mohamad Abo Ras -** Berliner Nanotest und Design GmbH, Berlin, Germany
2:40	**"Improved Heat Dissipation for High-Power Systems via Nanocopper-Based Metal SMT", Alfred A. Zinn** - Kuprion Inc. (Lockheed Martin), Palo Alto, CA
3:05	**"Electronic Coolants for Liquid Chillers and Direct Refrigerant Chillers for Electronic Systems", Randy Owen** - K-O Concepts Inc., Titusville, FL
3:00 – 4:30	**Refreshments & Raffles in the Exhibit Hall**

Morning Session	**Seminar Room**
8:30 – 11:30	**Session C: RF and Microwave - Innovations & Emerging Technologies** **Tom Terlizzi & Chandra Gupta – Co-Chairs**
8:30	**"Microwave and Millimeter Wave Multi-Chip Module Manufacturing", Earle Stewart** – HXI, LLC, Harvard, MA; **David Robbins** – Monzite Corp., Nashua, NH
8:55	**"Challenges of Microwave Assembly", Jay Chudasama** – Agile Microwave Technology Inc., Hicksville, NY
9:20	**"Design and Analysis of Antennas for a Modern Smartwatch", Tracey Vincent** – CST [Computer Simulation Technologies] - Framingham, MA
9:45 - 10:15	**Coffee Break in the Exhibit Hall**
10:15	**"Visual Identification of Organic Residue on Microelectronic Components via In-Process Visible Light Fluorescence", Tristan Baldwin,** Richard Rochford - BAE Systems, Nashua, NH
10:40	**"Hermetic System-in-Package for High Power RF MEMS Switch", Chris Keimel,** Kaustubh Nagarkar – Meino Micro - Irvine, CA
11:05	**"Device Physics Matters in RF Designs and Manufacturing",** Chandra Gupta – Communications & Power Industries, LLC, Beverly, MA
11:45 – 1:15	**Lunch & Keynote in the Exhibit Hall**

Afternoon Session	**Seminar Room**
1:00 – 3:05	**Session F: Printed Electronics** **Katherine Duncan & Craig Armiento – Co-Chairs**
1:00	**"Printing 3-D Nanostructures for Electronics and Sensors Applications", Cihan Yilmaz -** Flex Boston Innovation Center, Cambridge, MA
1:25	**"Inkjet Printable Etching and Plating Resists", Krishan Balantrapu -** Dow Electronic Materials, Marlborough, MA
1:50	**"3D Printing of Flexible and Stretchable Interconnects", Mike O'Reilly -** Optomec, Inc., Albuquerque, NM
2:15	**"Use of 3D Printed Antennas for RF Energy Harvesting Purposes", Charlotte Blair** – ANSYS Inc., Middlebury, CT
2:40	**"MIT Nano Centre Introduction", Dennis Grimard –** Massachusetts Institute of Technology, Cambridge, MA
3:00 – 4:30	**Refreshments & Raffles in the Exhibit Hall**

Exhibit Hall

Session G: Poster Session - Viewing All Day

Tom Marinis & Amaresh Mahapatra – Co-Chairs

Authors Review 2:00 PM – 3:30 PM

"Fabrication and Characterization of Novel Low Inductance Micro-Coaxial Cables", Daniela A. Torres, S.C Barron, A. Kopa, M.R Miller, A.P Magyar, P.H. Lewis, M.W. Meinhold, C.L. Gray - Draper, Cambridge, MA; R.D White - Tufts University, Medford, MA

"Optimal Design of Longitudinal-Fin Heat Sinks Accounting For Simultaneously Developing Flow and Conjugate Effects", Georgios Karamanis, Marc Hodes - Tufts University, Medford, MA

"Drone Delivery of Cold Chain Medical Supplies Viability and Efficacy", Michael Beinor, Evan Bosia, Scott Cazier, Keegan Train, Jianyu Liang, Gregory Fischer - Worcester Polytech Institute, Worcester, MA

"Verifying Electronic Component Cleanliness using Ion Chromatography", Scott Mazur - Benchmark Electronics, Nashua, NH

"Fabrication of Conformal Electronics Packaging with Microfluidic Eutectic Metal Interconnects", Nikolas Kastor, Robert D. White - Tufts University, Department of Mechanical Engineering, Medford, MA

iMAPS New England Chapter

Employment Center

- Job Postings -

Located in the Registration Area

The New England Chapter

Exhibit Hall

Vendor Exhibit – Open All Day !

Morning Technical Program

Session A: Nanoelectronics & Optoelectronics
Chaired by Yi Qian (MRSI Systems) & Jin Li (Cambridge Technology)
Colonial Room - 8:30 AM – 11:30 AM

8:30 – 8:55 AM Colonial Room

"Grand Challenges and Timelines for Electronic-Photonic Integration", Lionel C. Kimerling – Massachusetts Institute of Technology, Cambridge, MA

Transistor dimensional shrink enabled constant-cost performance scaling of integrated circuit chip performance at a rate of 100x/10yr. During the same period, interconnection proliferation among distributed resources has enabled computation system performance to scale at a rate of 1000x/10yr. Interconnection is now the scaling paradigm for chips and subsystems, and bandwidth density is the new shrink metric. Photonic interconnects are dominant in telecommunication networks, and they have successfully penetrated both data center and HPC rack-to-rack interconnection. In general, the transition from electronic to photonic interconnection occurs at a single-channel bandwidth x distance product of 1-3 Tb/s cm (BxD = 1-3 Tb/s cm). In 2017 single-channel bandwidth (B) will cross 400Gb/s threshold for board-level distances of >10cm. Board-level optical interconnection will require high volume manufacturing solutions with minimal impact on system cost. Package-level, intra-module photonic interconnection for distances of >1cm are forecast for ~2020 with data rates of 1-3Tb/s. Photonic interconnect solutions can meet system requirements for power and bandwidth density, but they have not yet met the cost point for pervasive intra-system deployment. Silicon photonics is being universally adopted to establish a 'future proof' platform that can achieve 'learning curve' cost reduction with cumulative production. Highlights of the recently released Integrated Photonics System Roadmap (IPSR 2016) will provide the context for discussion of the silicon photonics hardware platform, its architectural evolution over the next two decades and its monolithic integration with electronics for the next scaling paradigm.

8:55 – 9:20 AM Colonial Room

"Standoff Chemical Sensing Wireless Network of Traditional and Aerosol Inkjet Printed Conductors under Tensile and Strain", Xuejun Lu – University of Massachusetts Lowell, Lowell, MA

Optical remote chemical sensing is one of the most efficient non-contact chemical sensing technologies. Since many chemicals show molecular rotovibrational absorption in the mid-wave infrared and longwave infrared (MWIR/LWIR, 3-12 µm) spectral region, multispectral MWIR/LWIR sensing in the MWIR/LWIR can provide measurement of the chemical compositions and allows real-time identification of chemicals with high reliability. Because the multispectral remote chemical sensing technique doesn't need the de-absorption or replacement of sensing materials, it can avoid equipment contamination and allow continuous real-time chemical monitoring. In addition, the multispectral optical remote sensing technique can offer a much broader coverage area and detection distance than current chemical "sniffers", which requires physical contacts with chemicals to be detected.

The optical remote sensing units can be connected and form a wireless network that can provide distributed MWIR/LWIR optical remote chemical sensing with enhanced effectiveness, accuracy, and reliability. In addition, the MWIR/LWIR optical remote sensor network can provide additional information about the chemicals, including their exact location, distribution, dispersion area and spreading speed, etc.

In this talk, the working principle of the MWIR/LWIR optical remote chemical sensing wireless network will be presented together with the system design and implementation. The applications in chemical sensing, leak detection, environment monitoring, as well as explosive detection in security checkpoints will be discussed.

9:20 – 9:45 AM   Colonial Room

"Quantum Cascade Laser Power Scaling Developments", Jeffrey Shattuck - Forward Photonics, Wilmington, MA

Quantum cascade laser using wavelength beam combination (WBC) technology enables commercialization of mid-infrared laser modules with an order of magnitude more power than is otherwise available. We will review our latest mid-wave infrared (MWIR) laser capable of producing > 20 W in CW operation by using WBC to combine the outputs of individual high power QCLs. We will also review development of QCL array technology which would serve to shrink the size and weight of the current laser by a vast amount.
It is well known in industry of the cumbersomeness involved with the need of liquid based cooling system in packaging for dealing with the waste heat in these high powered QCL systems. Without adequate cooling in packaging, thermal induced mechanical stress is a leading mode of failure in QCLs. With this in mind, we has developed a fully air-cooled version of its WBC based MWIR laser. Such a system will provide great benefits in applications where liquid cooling is simply untenable.

9:45 – 10:15 Coffee Break in Exhibit Hall

10:15 – 10:40 AM   Colonial Room

"Wafer-level Integration and Packaging of Micro-Concentrating Photovoltaics", Juejun Hu, Lan Li, Duanhui Li, Tian Gu – Massachusetts Institute of Technology, Cambridge, MA; Bradley Jared, Gordon Keeler, Bill Miller, William Sweatt, Scott Paap, Michael Saavedra, Charles Alford, John Mudrick, Anna Tauke-Pedretti - Sandia National Laboratories, Albuquerque, NM; Ujjwal Das, Steve Hegedus, - Institute of Energy Conversion, University of Delaware, Newark, DE

Here we present a novel approach for integration and packaging of micro-scale concentrating photovoltaics (CPV) modules on a wafer-level platform. The Wafer Integrated Micro-scale PV approach (WPV) seamlessly integrates multijunction micro-cells with a multi-functional silicon platform that provides optical micro-concentration, hybrid photovoltaic, and mechanical micro-assembly. A >100% improvement on the concentration-acceptance-angle product is demonstrated using the wafer-embedded micro-concentrating elements, leading to dramatically reduced module materials and fabrication costs, sufficient angular tolerance for low-cost trackers, and an ultra-compact optical architecture, which makes the WPV module fully compatible with commercial flat panel infrastructures. Leveraging low-cost micro-fabrication and high-level integration techniques, the micro-scale PV approach effectively combines the high performance of multijunction solar cells and the low costs of flat-plate Si PV systems.

10:40 – 11:05 AM Colonial Room

"Challenges in Optical Sensor Module Packaging -Evolving from Past into Future", Julia Ying Zhao, David Bolognia – Analog Devices, Inc., Wilmington, MA

When micro-electronics IC was scaling down, precisely following Moore's law, we experienced small changes in device packaging requirements. Packaging technologies were highly standardized. Now, advanced packaging development activities are booming again, mainly driven by the interest of system-in-package applications, the vision beyond Moore's law. Particularly over the last 5 years, optical sensing in the mobile health and biomedical field raised the wave of integrating optical sensors with traditional semiconductor ICs to create compact and high performance systems. Micro and nano photonics devices emerge as part of the signal chain and direct interface with real world. We found ourselves facing requirements that go beyond standard packaging capability. The opto-electro system-in-package integration demands new material and equipment capability, and smart design. The wide spread of consumer and industrial applications puts pressure on lower cost solutions. This presentation gives a few examples of the challenges we face today in packaging biosensor modules and smart industrial sensor modules, and how previous obstacles were overcome to meet stringent customer requirements.

11:05 – 11:30 AM Colonial Room

"Automated Die Bonding for High Volume Optoelectronics Manufacturing: Speed, Accuracy, and Flexibility", Peter Cronin - MRSI Systems, Billerica MA

High volume manufacturing of optoelectronics presents a unique set of challenges relative to more mature and extremely high volume semiconductor electronics. Throughput requirements remain high but the equipment used must offer a high level of flexibility in addition to placement accuracy. This talk will describe some of the special process requirements for optoelectronics that drive the need for equipment flexibility along with speed and accuracy. These requirements include multiple attach processes such as epoxy and eutectic die attach in one package and multi-chip production in one machine. High volume equipment for optoelectronics assembly must be able to handle small chips on ceramic substrates as well as full size gold-box packages. In addition, active optical cables and advanced optical sensors for augmented/virtual reality requires attaching dies on printed circuit boards with automatic material loading and unloading capability. Current packaging equipment performs these processes for traditional optoelectronics while achieving 3 micron placement accuracy at semiconductor level throughputs. The new frontier using silicon photonics technology calls for submicron die bonding accuracy where speed and flexibility can both be improved in the future.

Lunch 11:45 – 1:15 PM in Exhibit Hall

Session B: MEMS & Nano Systems

Chaired by Robert White (Tufts University) & Rick Morrison (Draper)

Cotillion Room - 8:30 AM – 11:30 AM

8:30 – 8:55 AM Cotillion Room

"Miniature Multiwire Systems (MMS)", Caprice Gray Haley, Anthony Kopa, Andrew Magyar, Amy Duwel, Brian Smith, Sara Barron, Mitch Meinhold, and Seth Davis – Draper, Cambridge, MA

The Miniature Multiwire Systems IR&D will enable rapid packaging of small, complex electronics. This is done by breaking the conventional packaging paradigm, in which all chip-chip interconnects are made with as much as a couple dozen patterned redistribution layers, with a single layer of self-shielded wires (micro-coax). Depending on system requirements different types of wires will be needed. For digital signals, standard unshielded wire-bonds are sufficient. However, certain high speed signal will need miniaturized coax. In addition to signal handling, an MMS package will have a unique and novel way to handle power in low impedance micro-coax wires. The key integration challenges to realizing this technology include (1) creating a new power distribution network model, (2) fabricating and connecting sub-25 micron coax wires, and (3) building a custom tool that can automate the coax bonding process. In the first year of this research effort, we have made significant strides in understanding how to design an MMS system. We have proven that we can "rapid prototype" circuits with packaged components and eliminate costly fab time for multi-layer routing. We have also successfully created low impedance (0.5 ohm target) coax wires for power handling and methods to test these wires at high frequency. Over the next 2 years, we will take on the challenges of scaling up micro-coax wire fabrication, miniaturization of wires so we can move from package scale integration to chip scale, and process automation.

8:55 – 9:20 AM Cotillion Room

"A New Manufacturing Process for Fabricating 3D Interconnects for MEMS and ICs", Cihan Yilmaz, PhD - Flex Boston Innovation Center, Boston, MA

The current trend in semiconductor technology toward 3-D stacking of MEMS and IC devices provides the advantages of short interconnections, miniaturization, and compact packaging. In MEMS, the interconnection using TSV requires filling vias that are 10s of microns in diameter and 100s of microns in depth. However, fabrication of such large and high aspect ratio TSV interconnects by vias electroplating or thin film deposition is costly and technologically challenging. Similarly, future generation ICs demand for very small size (<16nm) and high aspect ratio interconnects, which are extremely challenging using conventional techniques. There is a need for the development of manufacturable and cost-effective alternative interconnect fabrication techniques. In this presentation, recent challenges in 3-D integration in MEMS and IC terms of manufacturing, scaling and yield issues are reviewed and new manufacturing methods are discussed. A new, material independent, room pressure and temperature manufacturing process for fabricating 3-D interconnects is introduced.

9:20 –9:45 AM Cotillion Room

"MEMS Packaging for Reliable, Low Pressure Sensing in Automotive Applications", Sam MacNaughton, Matt Lasorsa, Giff Plume – Sensata Technologies, Attleboro, MA

In the past 10 years, MEMS-based sensors have become the most common technology for low pressure (less than 100kPa) sensing in automotive applications, growing to a multibillion dollar market. Harsh environments such as that found in automotive applications present great challenges for MEMS devices. These challenges can be broadly categorized into three primary regimes: chemical, mechanical and thermal. The chemical constituents present challenges in that exhaust and other automotive media is corrosive to many MEMS materials. The vibrational and thermal profiles of underhood and underbody applications also present challenges to reliable MEMS packaging. This paper focuses on the design tradeoffs present in packaging piezoresistive MEMS sense elements with respect to signal integrity, vibrational interactions, and mitigating factors for chemical protection. Of particular focus is the susceptibilities and failure modes present with front-side metallization exposed to exhaust media. The concept is shown to function in temperatures ranging from -40C to 140C, vibrational loads up to 20Grms, and in chemical environments with pH as low as 1.6pH.

9:45 – 10:15 Coffee Break in Exhibit Hall

10:15 – 10:40 AM Cotillion Room

"Low Temperature, Hermetic Packaging of a MEMS Electric Field Sensor", Douglas Gauthier, Daniel Reilly, James Bickford, & Stephanie Golmon – Draper, Cambridge, MA

The packaging of electret transducers for MEMS scale electric field sensors presents a number of interesting challenges. These electrets are formed by embedding charge into dielectric materials. In the presence of an electric field these charges will experience an electromagnetic moment, and by coupling these electrets to a physical MEMS sensor, miniature electric field sensors can be produced.

The traditional vacuum packaging techniques used in MEMS sensors present a number of challenges when used in conjunction with electrets. Principally amongst them are the tendency of electrets to depolarize during packaging and a limited material set to avoid shunting the electric field around the electret. Depolarization of the electret can occur both during vacuum pumpdown and thermal cycling. Solutions and their implementation to these challenges are presented here.

Metals and high dielectric constant materials preferentially divert flux which can increase gain or reduce performance depending upon the relative physical configuration of the structures. Alternative, low dielectric materials are used for the main package and braze material are strategically placed away from the electret to avoid shunting the electric field away from the sensor.

Electret materials have a tendency to depolarize at elevated temperatures. This material phenomenon is similar to the Curie Effect shown in permanent magnets. The critical temperature of the electrets used in this application is below the brazing temperatures used in traditional gold tin eutectic, MEMS packaging. Alternative methods for vacuum sealing and their effectiveness are presented.

10:40 – 11:05 AM Cotillion Room

"Advanced Integration Program at BRIDG and the Reliability Issues with 2.5D / 3D Integration", Amit Kumar, John Allgair – BRIDG, Kissimmee, FL

The advent of Internet based activity (Mobile and connected devices, cloud based operation) is driving the microelectronics industry to come up with faster devices and smaller form factor. The traditional route to the CMOS miniaturization at device level scaling is almost close to its limit. The need for next generation smart sensors and other advanced devices is steering the semiconductor industry to look at materials beyond silicon. Our effort at BRIDG is to address this challenge through technology programs aimed at package level scaling and novel materials growth on conventional silicon platform. The advanced integration program at BRIDG aims at developing interposers with signal input/output (I/O) channels an order of magnitude higher than typically achieved. However, there are several pre and post processing challenges associated with such interposer development. This presentation will discuss the advance integration activity being pursued at BRIDG followed by discussion on some of the key challenges related to the device reliability.

11:05 – 11:30 AM Cotillion Room

"Tuning the Resonance Frequency of Piezoelectric MEMS Microphones by Sizing Acoustic Ports", Yu Hui, Jongsoo Choi, & Robert Littrell – Vesper MEMS, Boston, MA

The acoustic port of a MEMS microphone package acts not only to transmit sound pressure to the MEMS transducers, but also to partially block environmental contaminations such as water and dust. Capacitive MEMS microphones rely on a small capacitive sensing gap, making them vulnerable to water and dust. Therefore, the microphone acoustic port is normally restricted to a small size (typically 0.25 mm in diameter). Piezoelectric MEMS microphones, however, are naturally immune to water and dust, thanks to the absence of the small sensing gap. This attribute gives more flexibility in microphone package design. Taking advantage of this flexibility, this work demonstrates the tunability of the resonance frequency of piezoelectric MEMS microphones by adjusting the acoustic port size in the microphone package. The piezoelectric MEMS microphones in this work use aluminum nitride as the piezoelectric material, and they are packaged with JFETs in common source amplifier circuits to buffer the signal. They are packaged in a 4.72 mm x 3.76 mm x 1.5 mm package. By adjusting the diameter of the acoustic ports from 0.35 mm to 0.75 mm, the resonance frequency of these microphones can be tuned by 1.4 kHz. A lumped parameter model of the microphone package has been developed and it shows a reasonable agreement with the test results.

Lunch 11:45 – 1:15 PM in Exhibit Hall

Session C: RF & Microwave – Innovations & Emerging Technologies

Chaired by Tom Terlizzi (GM Systems LLC) & Chandra Gupta (RF & Microwave Solutions Consultant)

Seminar Room - 8:30 AM – 11:30 AM

8:30 – 8:55 AM Seminar Room

"Microwave and Millimeter Wave Multi-Chip Module Manufacturing", Earle Stewart – HXI, LLC, Harvard, MA; David Robbins – Monzite Corp., Nashua, NH

Microwave and millimeter wave technology has seen the proliferation of MMIC technology across a wide device array as well as and basic semiconductor materials: Silicon, GaAs, AlGaAs, SiGe, GaN, InP etc. Design and Manufacturing is increasingly connecting these monolithic devices along with supporting passive components like capacitors, inductors, and resistors. In RF through infrared technology, the careful placement of supporting components especially in the "Z" axis can be the difference between meeting electrical performance requirements and not. Very often this means dealing with soldered components in close proximity to epoxied components which have very different requirements for things like metallization, cleaning, tooling, and inspection.

8:55 – 9:20 AM Seminar Room

"**Challenges of Microwave Assembly**", Jay Chudasama – Agile Microwave Technology Inc., Hicksville, NY

RF and Microwave Hybrids, "Microwave Integrated Circuits" (MIC), RF and Microwave modules, Monolithic Microwave Integrated Circuits, MMIC all require a unique set of materials and processes necessary to achieve reliable operations in extreme military and commercial environments. This presentation will examine some of the critical challenges and aspects of "microwave packaging" from a practical perspective and compare to "Low electrical frequency" circuit manufacturing".

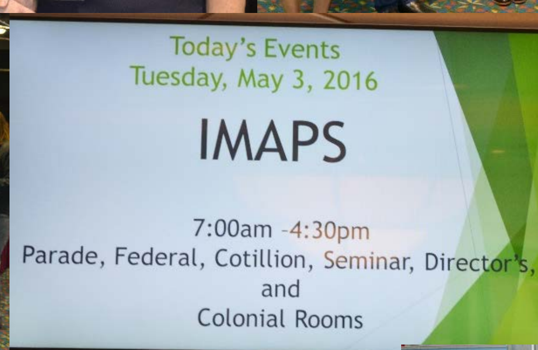
Valuable lessons learned from years of experience, design issues, material tradeoffs, process selection are covered in detail with the goal of imparting useful information to assemble and manufacture reliable microwave hybrids for military, space, and other high reliability commercial and medical device applications. [Continued on page 20].

Photos of the 43rd Symposium & Expo – May 3rd, 2016

Photos of the 43rd Symposium & Expo – May 3rd, 2016








9:20 – 9:45 AM   Seminar Room

"Design and Analysis of Antennas for a Modern Smartwatch", Tracey Vincent – CST [Computer Simulation Technologies] - Framingham, MA

Wearable electronics poses many challenges for the RF design engineer. When designing wearable consumer electronics in particular, rapidly evolving performance requirements, new usage scenarios and regulatory constraints make the ability to accurately and efficiently evaluate and consider different design options critical in being competitive. In this webinar, we will look at some of the challenges facing designers in the design of a new smartwatch product. The presentation will explore some design examples and discuss the design and analysis approaches in relation to the regulatory as well as electromagnetic and mechanical performance requirements for a typical commercial smartwatch.

9:45 – 10:15 Coffee Break in Exhibit Hall

10:15 – 10:40 AM   Seminar Room

"Visual Identification of Organic Residue on Microelectronic Components via In-Process Visible Light Fluorescence", Tristan Baldwin, Richard Rochford - BAE Systems, Nashua, NH

While fluorescence is commonly used to observe conformal coatings; such visual techniques have previously proven ineffective for the detection of epoxy resins in microelectronics hardware. Where UV fluorescing additives within an epoxy were prohibited, 460nm blue light demonstrated a strong ability to resolve thin layers of cured epoxy resins on microwave electronics modules. Epoxy resin bleed has plagued chip and wire assembly and was previously not detectable using low cost in-process techniques. Using a 460nm blue LED and a 515nm long pass filter it is possible to readily visualize cured epoxy resins and many other contaminants on gold bond pads and other microelectronics components. This fluorescence microscopy method can be integrated into existing bench top stereoscopes and does not require the use of expensive and often destructive analytical techniques such as IR spectroscopy or XPS. Similarly, this method can be easily adapted for use on modules of any size. Unlike UV fluorescence techniques, no hazardous wavelengths of light are used greatly reducing the health risks posed by broadband UV light sources.

10:40 – 11:05 AM   Seminar Room

"Hermetic System-in-Package for High Power RF MEMS Switch", Chris Keimel, Kaustubh Nagarkar – Meino Micro - Irvine, CA

A new RF MEMS switch package has been developed that is capable of handling up to 25W continuous wave (CW) power, with insertion loss <0.3dB, and isolation of -25dB, while operating at DC to 3 GHz. The Menlo Micro Digital-Micro-Switch technology platform is focused on applications such as high-power tunable resonators and filters, as well as electronically steerable antennas and phase shifters, which will be briefly discussed in the presentation. The high reliability device/package is capable to withstand over 3 Billion switching operations. The package consists of a wafer-level hermetic sealed glass-based micro-mechanical switch device, integrated with a stacked gate control driver silicon chip in a low-profile organic System-in-Package (SiP) configuration. An overview of the construction of the metal-MEMS device, wafer-level hermetic sealing, and package design will be discussed along with simulated and experimental RF test results. The RF MEMS device itself has low I^2R losses and the effect of including the gate control driver chip will be presented. Thermal implications of high-power handling at various temperatures will also be discussed. The presentation will conclude with an overview of the advanced packaging roadmap for future product designs.

11:05 – 11:30 AM   Seminar Room

"Device Physics Matters in RF Designs and Manufacturing", Chandra Gupta – Communications & Power Industries, LLC, Beverly, MA

This presentation covers high density planar 2.5D and 3D package challenges and proposes the elements of best designs and production of RF and microwave systems.

Reliability is built in the systems by taking numerous device physics constraints into account. Many of these such as activation energy, electro migration, hot carrier injection, dissimilar metals and whisker growth need to be taken in the sound designs that incorporate the good RF design practices. The production considerations incorporate overall the best value, manufacturability, quality, parts obsolescence, supply chain and support through the life of the systems. These issues will be covered and show that implementing these right measures leads to overall value and a lower total cost ownership.

Lunch 11:45 – 1:15 PM in Exhibit Hall

Keynote Lunch Address

"From Interconnect to Innovation in the DoD"

Presented by Dr. Livia Racz –

Assistant Leader of the Chemical, Microsystem & Nanoscale Technologies Group - Lincoln Laboratory - Lexington, MA

12:15 – 12:45 – Exhibit Hall

Afternoon Technical Program

Session D: Medical Device Packaging

Chaired by Caroline Bjune (Draper) & Steve LaFerriere (Yole Développement)
Colonial Room - 1:00 PM – 3:30 PM

1:00 – 1:25 PM Colonial Room

"Embedding of Active Components in LCP for Implantable Medical Devices", Susan Bagen – MST [Micro Systems Technologies], Mesa, AZ 85210; Dr. Eckardt Bihler, Dr. Marc Hauer - Dyconex AG, Switzerland

Liquid Crystal Polymer (LCP) is a thermoplastic polymeric dielectric material which has been shown to be biocompatible.[1,2] Substrates with embedded active components can be fabricated with LCP laminates. By embedding, LCP can be used to "package" bare semiconductor die, and when combined with appropriate patterning and metallization, provide redistribution of the die I/O as well as connections to leads and electrodes. Coils for data communication and near field power transfer can also be included inside the LCP package. Regular die with standard bond pad metallurgy are thinned down to 50 - 100 µm thickness and embedded into LCP substrates. The bond pads are contacted with plated vias to the metal layers inside the multi-layer LCP substrate. The total package thickness is less than 250 µm which is suitable for implants directly under the skin. Possible applications range from neurostimulation including electrodes for deep brain stimulation and various sensor-based monitoring devices.

In order to demonstrate potential for attaining the biostability required for medical implant applications, soak testing of the LCP package was performed. Results from long term soak tests of embedded die LCP packages in buffered phosphate saline (PBS) at elevated temperature are discussed. The results of this testing indicate the effectiveness of LCP for producing a hermetic packaging solution for active components under such conditions, thus demonstrating the potential for such packages to be permanently implanted in the human body.

References:
[1] J. Jeung, et al., "A novel multilayered planar coil based on biocompatible liquid crystal polymer for chronic pain implantation," Sensors and Actuators A: Physical, Volume 197, 1 August 2013, pp. 38-46. [2] S.W. Lee, et al., "Development of Microelectrode Arrays for Artificial Retinal Implants Using Liquid Crystal Polymers," IOVS, December 2009, Vol. 50, No. 12, pp. 5859-5866.

1:25 – 1:50 PM   Colonial Room

"Low-Cost Electronically-Controlled Prostheses for Transfemoral Amputees", Molly Berringer – Draper / Massachusetts Institute of Technology, Cambridge, MA

There is a large performance gap between low-cost, mechanical prostheses and expensive, electronically-controlled prostheses for transfemoral amputees. A low-cost option with better performance is needed and it should mimic able-bodied gait in order to reduce the metabolic cost to the amputee and to mitigate discrimination that amputees may face. The most critical component of the transfemoral prosthesis is the design of the knee mechanism. The current design is an improvement upon a previous knee design created at MIT by Murthy Arelekatti and Amos Winter. This new design addressed issues identified through user testing in India. The improved design removes the reliance on friction pad damping, reduces backlash, and improves the kinematics of the knee. These improvements were accomplished while focusing on creating early-stance flexion, and improving stance stability and swing-phase control. The final prosthesis includes a modular early stance flexion component, a mechanical latch with a virtual axis, and a hydraulic rotary system within a compact design.

1:50 – 2:15 PM   Colonial Room

"The Use of Advanced Microelectronic Packaging Techniques to Miniaturize Implantable Neuro Stimulators", Jim Ohneck – AEMtec/Exceet North America, Cleveland / Akron, OH

Implantable Neurostimulators are being used to treat a number of Modalities, such as treatment for Chronic Pain using the Spinal Cord Stimulation (SCS) approach, Deep Brain Stimulation (DBS) for epilepsy and Parkinson's disease, and in limited cases Urinary Incontinence.

One of the barriers for Neuromodulation market growth is patient acceptance for an implant. Smaller unobtrusive and "invisible" devices will lend to an increased acceptance thus more implantations. Smaller is also viewed as less intimidating to the patient. On the other hand, practitioners such as Doctors and care givers perceive smaller devices as being more advanced technically, thus smaller devices are expected to increase adoption amongst healthcare professionals. Practitioners also want the best for their patients, so they would be more apt to prescribe a smaller device than a larger one.

Further, it is also desirable to have the implant sense the onset of potential attack, analyze signals and assume autonomous actions to counteract effect; this is referred to as "Closed loop Stimulation".

This presentation will review packaging techniques for several neurostimulation devices and discuss a revolutionary neurostimulation implant used in a novel approach for the treatment of Parkinson's disease which employs closed loop stimulation. The methods used in the design approach to determine the optimum way to achieve the size requirements will be discussed as will be the final microelectronic manufacturing techniques employed and why they were chosen.

Adding the closed loop feature and reducing the overall size of the implant required implementation of a multilayered flex board with tight line spacing requirements and die attach for the sensing circuit and microcontroller which are in bare die form. Attachment techniques such as gold ball wire bonding and various types of Flip chip attachment were considered; therefore, the presentation will discuss how the final manufacturing techniques and form factor were arrived at that ensured a robust design and long term reliability.

2:15 – 2:40 PM   Colonial Room

"Chromatic Mechanical Response in 2-D Layered Transition Metal Dichalcogenide (TMDs) based Nanocomposites", Balaji Panchapakesan - Worcester Polytechnic Institute, Worcester, MA

The ability to convert photons of different wavelengths directly into mechanical motion is of significant interest in many energy conversion and reconfigurable technologies. Here, using few layer 2H-MoS2nanosheets, layer by layer process of nanocomposite fabrication, and strain engineering, we demonstrate a reversible and chromatic mechanical response in MoS2-nanocomposites between 405 nm to 808 nm with large stress release. The chromatic mechanical response originates from the d orbitals and is related to the strength of the direct exciton resonance A and B of the few layer 2H-MoS2 affecting optical absorption and subsequent mechanical response of the nanocomposite. Applying uniaxial tensile strains to the semiconducting few-layer 2H-MoS2 crystals in the nanocomposite resulted in spatially varying energy levels inside the nanocomposite that enhanced the broadband optical absorption up to 2.3 eV and subsequent mechanical response. The unique photomechanical response in 2H-MoS2 based nanocomposites is a result of the rich d electron physics not available to nanocomposites based on sp bonded graphene and carbon nanotubes, as well as nanocomposite based on metallic nanoparticles. The reversible strain dependent optical absorption suggest applications in broad range of energy conversion technologies that is not achievable using conventional thin film semiconductors.

2:40 – 3:05 PM   Colonial Room

"Dragonfleye - Ultraminiature Cybernetic Insect Control Using Optogenetics", Carlos Segura, Jesse Wheeler, Joseph Register, John Le Blanc, Parshant Kumar, Dennis Callahan, Charles Lissandrello, Aaron Stoddard, Andrew Czarnecki, Christopher Salthouse, Alexander Oliva, – Draper, Cambridge, MA

Research in ultraminiature cybernetic insect control using optogenetics has been recently undertaken at Draper in Cambridge. Potential applications of the technologies underpinning DRAGONFLeye include guided pollination, payload delivery, reconnaissance, and even precision medicine and diagnostics. The smallest robotic aerial drones mimic insects in many ways, but none can match the efficiency and maneuverability of the dragonfly. The project challenges range from lightweight electronics packaging to optogenetic hardware techniques. In order to create guidable and controllable insects, the team is combining miniaturized navigation, synthetic biology and neurotechnology. The system is realized as a miniature electronics backpack worn by the dragonfly. One of the main features of this new capability is the development of a navigation system that can provide the position of the insect at all times without the use of heavy, bulky, or power-hungry hardware. In this talk, we discuss the project and show our current advancements demonstrated by the team in microelectronics integration to produce one of the world's smallest navigation systems.

3:05 – 3:30 PM   Colonial Room

"Thread Based Sensors & Interconnects for Medical Diagnostics", Meera Punjiya – Tufts University, Medford, MA

Threads, traditionally used in the apparel industry, have recently emerged as a promising medium for flexible electronics, microfluidics and physical and chemical sensors. These same threads provide inherent flexible interconnects between sensors, microfluidics and readout electronics, eliminating the need for more advanced packaging technologies in thread-based devices. Standard sewing methods allow for easy integration of these devices with their target environment.

We have demonstrated a tool-kit of threads capable of physical and chemical biosensing and drug delivery. The sensors are fabricated using inexpensive, clean-room free processes using various nanomaterials and hydrogels and are connected to electronic circuitry using thread-based flexible interconnects for readout, signal conditioning, and wireless transmission. Here we exhibit threads capable of in vitro and in vivo strain measurement, gastric pH measurement and on-demand drug delivery with integrated fluidic channels.

Threads are functionalized using carbon nanotubes, polyaniline, commercially available conductive inks and a PEGDA/alginate heat-sensitive hydrogel. The resulting strain sensors exhibit a gauge factor of 3 and pH measurement shows a sensitivity of -59.6 mV/pH. On-demand drug delivery is completed for healing of diabetic ulcers.

Afternoon Technical Program

Session E: Thermal Management
Chaired by Dave Saums (DS&A LLC)
Cotillion Room - 1:00 PM – 3:05 PM

1:00 – 1:25 PM Cotillion Room

"Automation of Die Attach of Si onto Cu using BondFlow™", Richard Koba, Kent Hutchings **–** Materion, Tyngsboro, MA**;** Jim Fraivillig - Fraivillig Technologies, Boston, MA; Peter Cronin - MRSI Systems, North Billerica, MA

BondFlow™ is a new die attach material that can be spin coated onto the backside of a wafer and B-staged. The adhesive is thermoplastic polyimide (TPI) which is thermally stable in air to 300˚C for several hours. The TPI is made electrically and thermally conductive by adding silver particles. After B-staging, BondFlow has a long shelf life and is not tacky. Previous research has demonstrated that BondFlow can be spin coated onto the backside of an aluminum-metallized silicon wafer, B-staged, placed on dicing tape, diced, and then bonded to an aluminum substrate using a high throughput MRSI M3 die attach system. A void-free bondline was formed despite the severe CTE mismatch between Si and Al.

A goal of the present study was to investigate the automated bonding of silicon (2.6 ppm/˚C) dice onto copper (17 ppm/˚C) substrates plated with electroless Ni + electroless Pd + immersion Au (ENEPIG.) An MRSI production die attach system was used for this investigation. The MRSI system was capable of preheating the substrate and controlling the downward pressure of the collet onto the preform and Si chip. The quality of the bond was measured by C-SAM imaging and by die shear, both as-cured and after temperature cycling. The suitability of BondFlow for high volume die attach onto ENEPIG-plated copper was quantified. The relative advantages of BondFlow relative to other die attach materials (including solder, epoxy and sintered nanosilver) will be discussed.

1:25 – 1:50 PM Cotillion Room

"Market, Regulatory, Packaging, and Thermal Design Issues for Implantable Medical, Handheld, and Mobile Devices", David L. Saums - DS&A LLC, Amesbury, MA

A very wide range of different types of mobile, handheld, and wearable electronic devices now exist for consumer, security, and military applications. Similarly, an extensive array of medical electronic devices are now designed and manufactured for use in monitoring and improving human health. The overall market for all types of such mobile, handheld, wearable, and implantable devices has grown explosively and new developments continue. A specific area of significant growth, beyond such consumer products as smart phones and tablets, is the medical device market.

The market for medical devices intended to be worn externally, implanted in the body, or consumed orally is expected to be over $50 billion worldwide over the next three years and growing rapidly. This presents opportunities for product design, material selection, and problem solving in order to achieve practical and beneficial electronic products. These devices must be developed, designed, and marketed within a complex range of regulatory requirements and meet consumer expectations for sports and health monitoring capabilities with the opportunity to impact clinical performance. These devices also potentially raise new questions at a societal level regarding privacy of data generated, data storage, and how "big data" rules and requirements may need to change to accommodate societal and privacy expectations. This presentation will outline the functional packaging, thermal, and materials requirements for handheld, mobile, wearable, and implantable electronic devices, the current regulatory landscape and impact on device design and functionality. Examining this market is useful for understanding materials requirements for energy storage and for power, RF, and integrated circuit components within such end products.

Discussion will follow this outline:

1. Product concepts
   a. Needs analysis – fit, form, function
   b. Current mobile, handheld, and wearable electronic devices: packaging, thermal characteristics by general product type
   c. Implantable and ingestible medical electronic devices: packaging and thermal issues
   d. Future developments for wearable and implantable medical electronic devices.

2. Regulatory environment and impact of regulation:
   a. Principal U.S. and E.U. regulatory agencies and relevant regulations.
3. Societal expectations and potential issues for data generation, monitoring, storage, and use as “big data” for medical research and other uses.
4. Needs for materials and thermal solution developments for miniaturized wearable, implantable, and ingestible medical electronic devices.

1:50 – 2:15 PM   Cotillion Room

“Efforts Toward a Board Level Holistic Thermal and EMI Solution for Mobile Electronic Devices”, Eugene Pruss, Jason Strader - Laird Technologies, Cleveland, OH

Thermal and EMI management in electronic devices is an increasing challenge for device manufacturers. Several trends such as increasing device density, both at the chip and board level, coupled with the reduction in overall device thickness influence device manufactures’ approach these challenges. In most electronic devices, these thermal and EMI challenges are addressed separately through the use of individual board level shields, thermal interface materials, and heat spreaders. These products typically provide only one solution and in mobile electronic devices may unintentionally influence each other’s performance in the device after their implementation. In this presentation we will discuss work that we have performed at Laird to design an integrated solution for thermal and EMI management at the board level.

Our integrated solution has been evaluated in several mobile electronic devices. Two case studies will be presented demonstrating its effectiveness in smartphones. The first case study utilizes a mid-range smartphone and the second a flagship smartphone. The goal of the evaluations was to quantify improvements in both CPU performance and device skin temperature provided by our integrated solution. Full device functionality was maintained with our solution in both cases. Device performance was measured by the increase in clock speed of the CPU. Increases of CPU clock speed by as much as 40% were observed in the mid-range smartphone. Reductions of skin temperature were obtained in the flagship smartphone of up to 4˚C with modest increases of the CPU clock speed. The design of the integrated solution includes a heat spreader and specific thermal interface materials selected to manage heat flow at the board level. Several alternatives to board level shields such as synthetic graphite and conductive fabric were evaluated to provide EMI shielding while reducing thickness and promoting integration.

2:15 – 2:40 PM   Cotillion Room

“Thermal Test Chip for Thermal Characterization and Qualification of Materials and Semiconductor Packages”, Mohamad Abo Ras - Berliner Nanotest und Design GmbH, Berlin, Germany

This work presents a novel thermal test chip (TTC) designed for thermal characterization, reliability investigation, and monitoring of semiconductor packages, thermal materials, and package materials.

The TTC is designed as a modular die with the smallest full functional die cell of 3.2mm x 3.2mm, consisting of heater structure and a temperature sensor. Figure 1 (below) illustrates the layout of a single cell (left) and 3x3 cell matrix (right).

The TTC can be used in any desired matrix, such as square or rectangular. All temperature sensors, whether in a single cell or an arrayed cell configuration, can be addressed individually to allow highly localized temperature measurement. Heating resistors on each die cell can be powered individually in serial or parallel configuration, highly useful for characterization of specific applications to mimic different electrical resistance values, hot spots, and heat fluxes.

Two types have been developed. One is intended for flip-chip die with a pure silicon backside. The second is intended for wire bond packages with gold backside metallization. Unique design challenges for these TTCs included design of the heater structure and temperature sensor with only a single titanium layer as adhesion and barrier layer.

These thermal test die can be used for applications such as : - Characterization of thermal interface materials (TIMs) under real conditions, as the TIM can be tested between silicon and metal surfaces.

2:40 – 3:05 PM Cotillion Room

"Improved Heat Dissipation for High-Power Systems via Nanocopper-Based Metal SMT", Alfred A. Zinn - Kuprion Inc. (Lockheed Martin), Palo Alto, CA

AuSn solder is often used for SMT of high power devices, LED dies and laser diodes due to its high temperature capabilities and decent thermal performance. However, the material is reaching its performance limits for ever increasing heat dissipation requirements for new LED and laser diode products that have reached the kW range. Therefore, there is a need for a new SMT that can offer higher thermal performance. To fill that need, we developed a nanocopper-based interconnect material as a robust, high-performance alternative. This solder-free nanocopper material overcomes a fundamental limitation of traditional solders in which the processing temperature imposes an upper ceiling for maximum allowable thermal operating conditions. For the first time, we can provide an interconnect material that is capable of operating at temperatures above the original processing temperature. Once fused, the material transforms back to bulk copper with a melting point of 1084 C forming contacts that can exceed 5-times the thermal and electrical conductivity of typical solder systems. The material rheology is tunable for drop-in replacement of solder on standard PCB assembly lines and other common paste dispensing production equipment. Interconnects produced from such a material can exhibit improved creep resistance and enhanced reliability in low- and high-temperature operating environments. The nanocopper material is manufactured in solution from the reduction of a copper salt with a reducing agent in the presence of amine surfactants that control particle size and protect the nanoparticles from oxidation. The manufacturing process is readily scalable with a 1 kg pilot plant currently in operation. A path to a continuous low-cost manufacturing process has been identified. A readily dispensable nanocopper paste was used to bond commercial LEDs to a thermal heat sink. A large number of test samples was fabricated to measure mechanical strength. Shear strengths as high as 80 MPa were measured using 4-6 min reflow profiles with peak temperatures around 260 C.

3:05 – 3:30 PM Cotillion Room

"Electronic Coolants for Liquid Chillers and Direct Refrigerant Chillers for Electronic Systems", Randy Owen - K-O Concepts Inc., Titusville, FL

Use of liquid chillers and direct refrigerant cooling for electronic systems will be discussed in this presentation, with a focus on the range of electronic coolants available and in use across military, aerospace, laser, medical, semiconductor test, and other market segment applications.

Electronic coolants include the use of water in various forms (deionized, water/glycol, and other additives), a range of dielectric liquids, certain refrigerants, and some developing so-called nanofluids. A set of tables will be presented to outline the various characteristics of these fluids, including boiling point, freezing point, GWP value, flashpoint, dielectric constant, vapor pressure, and similar. The purpose is to illustrate the options available and some of the primary advantages and disadvantages of certain fluids for use as a coolant in single-phase and two-phase liquid cooling systems for electronics thermal management.

Liquid chillers and direct refrigerant cooling systems will also be discussed, illustrating principal components of each type of system, coolants used, types of pumps and compressors, and physical dimensions and capacities for different types of rackmount and standalone cooling systems. Comparison of efficiencies achieved with different chiller system designs will also be included.

Chillers and direct refrigerant cooling systems have significant design and performance differences and understanding these differences is important in evaluating and selecting such systems for use in electronic systems. Chillers can be either rackmount, for insertion directly into an industry-standard test system or other electronics enclosure, or floor-standing. A well-designed chiller can occupy as little as forty percent of the volume of a competing chiller; electrical efficiency is an additional noticeable difference between types of chillers. The ability to closely control system temperature variation to a given temperature set point is a feature which can be critical within certain types of laser diode and electro-optical systems, to maintain laser or imaging system performance, for example.

Session F: Printed Electronics
Chaired by Katherine J. Duncan (US Army, Printed RF Structures Group) & Craig Armiento (UMass Lowell, Printed Electronics Research Collaborative)
Seminar Room - 1:00 PM – 3:05 PM

1:00 – 1:25 PM   Seminar Room

"Printing 3-D Nanostructures for Electronics and Sensors Applications", Cihan Yilmaz - Flex Boston Innovation Center, Cambridge, MA

In this work, we developed a directed assembly technique that enables assembly and fusion (printing) of various metallic and semiconductor NPs to fabricate highly organized 3-D crystalline, solid nanostructures on surfaces. In this technique, colloidal NPs are assembled and simultaneously fused (printed) into 3-D nanostructures using an externally applied electric field. Using this method, we fabricated 3-D nanostructures made from gold, copper, aluminum, tungsten and silicon with feature sizes as small as 25 nm in less than a minute at room temperature and pressure without the need for a seed layer and chemical additives. The control of nanostructure dimensions was investigated as a function of many governing parameters such as voltage, frequency, assembly time and particle concentration. Material and electrical characterizations revealed that fabricated gold nanostructures have polycrystalline nature, very low resistivity (1.96×10^{7} Ω m) and demonstrate high optical quality supporting strong plasmonic resonances with line-widths as narrow as 13 nm. This enables highly sensitive plasmonic-based biosensing of proteins. These results indicate that the presented approach will facilitate fabrication of novel 3-D nanomaterials (homogeneous or hybrid) in an aqueous solution at room temperature and pressure, while addressing many of the manufacturing challenges in semiconductor nanoelectronics and nanophotonics.

1:25 – 1:50 PM   Seminar Room

"Inkjet Printable Etching and Plating Resists", Krishan Balantrapu - Dow Electronic Materials, Marlborough, MA

Masking technology is widely used in the manufacture of electronics, connectors, precision parts, and even in decorative metal working. The common thread in all these industries is the use of subtractive etching techniques and additive plating techniques to build the end product. Commonly used masking materials include liquid and dry film photoresists, both of which require extensive equipment manufacturing costs. Use of photoresist technology also requires wet chemistry development steps, as well as the associated rinse water and waste streams that accompany them.
As an alternative processing scheme to masking technology, an inkjet printable resist material can be printed only in the areas of the substrate where resist is desired. The use of inkjet printable resists eliminates the lamination and wet chemistry development steps, masks, alignment, and rinse water associated with the development of the photoresist. Previous attempts at inkjet printable resists, however, have resulted in photoresist-based inks that have spreading issues upon printing, or the use of wax-based inks that have limited rigidity and chemical resistance. Presented here is a series of *hybrid* inks that combine the best attributes of both ink options. These inks give remarkable structural integrity upon printing and significant chemical resistance to etching and plating chemistries upon exposure.
LITHOJET™ inks are currently being used in a variety of commercial applications. The inks can be tailored for use in various industries by making small changes in the formulation. The photochemical machining industry version of the ink can be used as a strong etch resist, withstanding the harsh etching capability of Ferric chloride to etch up to > 15 mils deep. The printed circuit board ink can be used as an etch resist in place of dry film for inner layers, and as an electroplating resist for tin plating. The connector ink can be used as a plating resist in gold electroplating baths to reduce the amount of gold electroplated in undesirable areas of the connector.

This presentation explores the promise of what inkjet printing can bring to process simplification, cost reduction and improved capabilities in the photochemical milling, printed circuit board, connector, and metal working industries.

1:50 – 2:15 PM   Seminar Room

"3D Printing of Flexible and Stretchable Interconnects", Mike O'Reilly - Optomec, Inc., Albuquerque, NM

Flexible hybrid circuits typically require interconnecting rigid bare silicon or packaged die to a flexible circuit board. Flexing these assemblies can cause extreme stress on the electrical connections, especially near the edge of the chip where it mates with the substrate. Much of the stress can be relieved by first printing an elastic fillet at the base of the chip to form a flexible ramp leading to the surface. Metal ink traces can then be printed along the ramp to connect between the board and chip I/O. Aerosol Jet® is an ideal printing tool for precision deposition of polymeric and metal inks in this 3D application. It is a non-contact, high resolution printing technology that is compatible with a wide range of conductive, insulating, and resistive materials. We will present the printing of robust, flexible and stretchable 3D interconnects with line and space below 50 micrometers and good stability under thermal cycling. We also present the printing of passive electronic components and sensors.

Key words: Aerosol Jet, 3D Interconnects, Flexible Hybrid Circuits, 3D Printing

---

2:15 – 2:40 PM Seminar Room

"Use of 3D Printed Antennas for RF Energy Harvesting Purposes", Charlotte Blair – ANSYS Inc., Middlebury, CT

RF Energy harvesting using 3D printed materials is a growing application both in commercial and military applications. RF energy harvesting is the use of indirect or scattered energy to enable wireless charging of low power devices such as batteries for radios, GPS devices or any other sensors. The military is interested in keeping these devices light weight and energy efficient as the devices that they need to carry can add on additional weight of up to 15 pounds. This paper will focus on the effects of using different 3D printed materials and fabrication techniques to create a planar antenna at 1 GHz. Both patch and slot type of antennas will be investigated. The dimensional length and width and proximity of the lines created with the different 3D processes will be investigated as they directly impact the functionality of each antenna and its related circuitry. The planarity of the 3D printed surface will also be addressed as part of this investigation.

2:40 – 3:05 PM Seminar Room

"MIT Nano Centre Introduction", Dennis Grimard – Massachusetts Institute of Technology, Cambridge, MA

Dr. Grimard has co-authored numerous papers dealing with the theoretical and practical limitations of RF metrology and feed-forward control and has been awarded more than 32 patents covering every aspect of semiconductor tool technology. This paper focus on the extreme facility requirements for the new MIT.nano Building, the issues they presented, and how they were resolved.

What is MIT.nano? It is an advanced facility open to the entire community of faculty, researchers, and students. A convening space to spark collaboration and cross-pollination. A hive for tinkering with atoms, one by one—and for constructing, from these fantastically small building blocks, a future of infinite possibility.

What Will MIT.nano Do? MIT.nano will create a single facility with complete nano capabilities and place a world-class, shared tool set at the heart of the campus. It will create a nexus for collaboration and cross-disciplinary problem-solving as well as educate the next generation of leaders and it is powered by innovation at MIT — and around the world.

Session G: Poster Papers

Chaired by Tom Marinis (Draper) & Amaresh Mahapatra (Linden Photonics, Inc.)

In Exhibit Hall – All Day Authors Review: 2:00 – 3:30 PM

"Fabrication and Characterization of Novel Low Inductance Micro-Coaxial Cables", Daniela A. Torres, S.C. Barron, A. Kopa, M.R. Miller, A.P. Magyar, P.H. Lewis, M.W. Meinhold, C.L. Gray - Draper, Cambridge, MA;
R.D. White - Tufts University, Medford, MA

We have developed low inductance micro-coaxial cables to supply power to microchips. Our uniquely-low inductance cables are enabled by very thin dielectric compared to a conventional 50Ω cable. These cables will be used in a novel packaging platform in which traditional interconnects are replaced by micro-scale coaxial cables. This method saves time, cost, and labor for small production volume, custom electronics, compared to conventional multi-layered packaging techniques. These micro-coaxial cables are designed to have minimal inductance in order to meet the stringent power supply requirements of today's most power hungry chips, e.g. a Kintex 7 FPGA. One cable fabricated by Draper, and one fabricated by Sandvik Palm Coast are the focus of this presentation. The Draper cable consists of a 5 mil Copper core, 12 μm polyester-imide dielectric layer, and 55 μm Gold shield. The measured capacitance and inductance of the Draper cable is 0.93 pF/mm and 40 pH/mm respectively. The Sandvik cable consists of a 6 Mil Copper Core, 4 um polyurethane dielectric layer, and 44 um of Silver. The Sandvik cable has a measured capacitance of 2.38 pF/mm and measured inductance of 22.1 pH/mm. For comparison, a 50Ω cable of similar diameter has 202 pH/mm and typical bond wire has 1000pH/mm. The coax inductance is so low that inductance from the cable attachment points completely dominates and new attachment methods are under investigation.

"Optimal Design of Longitudinal-Fin Heat Sinks Accounting For Simultaneously Developing Flow and Conjugate Effects", Georgios Karamanis, Marc Hodes - Tufts University, Medford, MA

The thermal resistance per unit width of a fully-shrouded longitudinal-fin heat sink (LFHS) with an isothermal base is expressed in dimensionless form as a function of the conjugate mean Nusselt number, and an optimization algorithm is developed to determine the optimal fin spacing, thickness, and length that minimize the thermal resistance of the LFHS under conditions of simultaneously developing laminar flow requiring minimal algebraic computations. Prescribed quantities are the density, viscosity, thermal conductivity, and specific heat capacity of the fluid, the thermal conductivity and height of the fins, and the pressure drop across the LFHS. The present study is distinct from previous work because we do not assume a uniform heat transfer coefficient, but fully capture the velocity and temperature fields by numerically solving the conjugate heat transfer problem in dimensionless form to compute the conjugate mean Nusselt number. The results are relevant to, e.g., electronics cooling applications where heat spreaders or vapor chambers are utilized to make the base of heat sinks essentially isothermal.

"Drone Delivery of Cold Chain Medical Supplies Viability and Efficacy", Michael Beinor, Evan Bosia, Scott Cazier, Keegan Train, Jianyu Liang, Gregory Fischer - Worcester Polytech Institute, Worcester, MA

More than a billion people in the world lack access to all weather roads, leading to major difficulties in health services distribution. Many have proposed the use of Unmanned Aerial Systems (UAS) to improve the last leg of the supply chain. These proposals have addressed the distribution but not the cold chain required by critical supplies like vaccines. The development of lightweight, actively cooled chain technology for drones is crucial to the expansion of the supply chain's final leg. The following explains the development of a system to maintain and monitor the package for temperature, location, and supply integrity. Using simple materials and 3-D printed parts to insulate and actively cool the internal chamber the system meets established minimum volumes for medical supply transport via UAS. A simple SMS based communication protocol and modular attachment mechanism allows the device to be used by anyone with any UAS. Validation of the 2-8 C° target will be verified using WHO prequalified Vaccine Vial Monitors (VVM's) proving the viability and efficacy of the use of UAS in cold chain supply distribution.

"Verifying Electronic Component Cleanliness using Ion Chromatography", Scott Mazur - Benchmark Electronics, Nashua, NH

Verifying Electronic Component Cleanliness using Ion Chromatography will detail the benefits, process and criteria specifics of verifying ionic cleanliness of electronic components, printed circuit assemblies and processes with using Ion Chromatography. An overview of the Ion Chromatography process and technology will also be provided to detail the equipment and specifics of techniques. Acceptable criteria and sample analysis will also be presented to interpret the output results of Ion Chromatography and determine if the results are acceptable, process indicators or unacceptable with potential causes.

"Fabrication of Conformal Electronics Packaging with Microfluidic Eutectic Metal Interconnects", Nikolas Kastor, Robert D. White - Tufts University, Department of Mechanical Engineering, Medford, MA

In the design of modern robots, the ability to negotiate unstructured environments while not damaging or being damaged by its surroundings is an important consideration. Some such applications range from disaster relief, search and rescue, structure inspection, surveillance and medical diagnostics; to physical therapy and human machine interaction. In order to make robots much more approachable, and less likely to damage their environment, one approach is to build the robots using soft and flexible materials [1, 2]. The development of soft robots is constrained by the inclusion of electronic circuits. Traditional rigid printed circuit boards add stiffness when the desire is flexibility and polyimide flex circuits are not extensible when the desire is to compress and stretch the robot. A circuit that conforms and stretches in the same manner as the soft robot body is needed. In response, we have developed a method of manufacturing electronics packaging for off-the-shelf components (e.g. surface mount devices or SMD) using room temperature liquid eutectic gallium-indium (eGaIn) interconnects and cast silicone encapsulation. The process includes standard SU-8 lithography for making a micro-mold where the SMD components are placed and encapsulated with polydimethylsiloxane (PDMS). Consideration of forming 3D micro-channels, adhesion between SMD packages and PDMS, release from the mold, sealing of the micro-channels and evacuating the air so the channels can be filled, created a reliable electronics package for the use in soft robots.

[1] S. Kim, C. Laschi, and B. Trimmer, "Soft robotics: a bioinspired evolution in robotics," *Trends in biotechnology,* vol. 31, pp. 287-294, 2013.

[2] B. A. Trimmer, H.-T. Lin, A. Baryshyan, G. G. Leisk, and D. L. Kaplan, "Towards a biomorphic soft robot: design constraints and solutions," in *2012 4th IEEE RAS & EMBS International Conference on Biomedical Robotics and Biomechatronics (BioRob)*, 2012, pp. 599-605.

Exhibits *** Exhibits *** Exhibits

Refreshments, Hors d'oeuvres, Raffles, & Fun in the Exhibit Hall Until 4:30 PM

Our 2017 Sponsors

44th Symposium & Expo – May 2nd 2017

IMAPS

MRSI Systems

riv

MSI Mini-Systems, Inc.

IMAPS The New England Chapter

Stellar Industries

Geib Refining Corp. Dependable Precious Metal Reclamation

GREEN TJ Green Associates, LLC

Technic Inc

Boston Micro-Components

Metallix Refining Inc

EMA

Epoxy Technology 50 Plus 1966 - 2017

AiT

hönle UV America Inc

PM Industries Custom Manufacturing Services

Proton On Site

Air Products

Centerline Technologies

Creyr Innovation, LLC Technology Solutions Provider & Supplier Representative

advance reproductions corporation

MSD

Nordson EFD

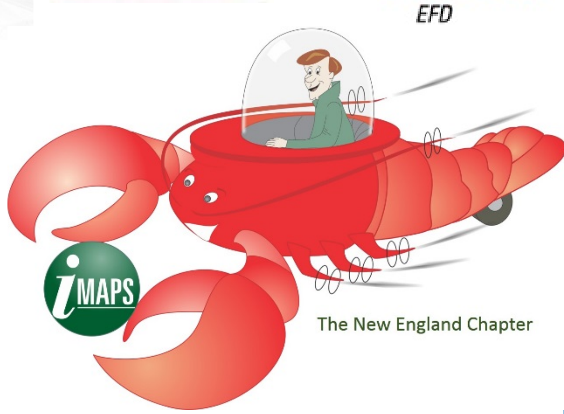
Kyocera

XYZTEC

Sonoscan Sound Technology With Vision

Laser Services

finetech



NDC NDC International

PEI

UTZ

EMSL Analytical, Inc.

Heraeus

UBOTIC MEMS & Sensor Integrator

The Jetsons® 2017

GOWANDA

Golden Altos Corporation

CiREXX International

Innovative Fabrication

Thin-Films Research, Inc

MST Micro Systems Technologies engineering for life

Ferro

cwi technical sales

MMS Technical Manufacturers' Representative

SETNA

LFG Micro

NGK NTK Spark Plugs Technical Ceramics NTK Technologies, Inc.

Materion

Century Seals

ATV Thermal Processing

REMTEC® Ceramic Packaging Solutions For Optimum Performance

Kemlab

Hesse Mechatronics

Palomar Technologies

Coining

MCC Micro Chem Innovative Chemical Solutions for MEMS and Microelectronics

Tentech LLC Services & Solutions

Precision Engineered Products

General Metal Finishing

AdTech Ceramics

List: 24-Apr-2017

iMAPS New England

Gratefully Acknowledges
Our 44th Symposium & Expo Sponsors

Our 2017 GOLD Sponsors

MSI MINI-SYSTEMS, INC.

MRSI SYSTEMS

Geib Refining Corp.
Dependable Precious Metal Reclamation

GREEN TJ GREEN ASSOCIATES, LLC

STELLAR industries

TECHNIC INC

VIV

Our 2017 Silver Sponsor

METALLIX REFINING INC

2017 Media Sponsors

GLOBALSOLAR TECHNOLOGY

GLOBAL SMT & PACKAGING

Global LEDs/OLEDs

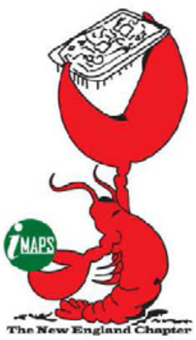
List: 17-Apr-2017

Call for Papers

iMAPS New England – 45th Symposium & Expo

The Largest New England Symposium Dedicated to Microelectronics and Packaging

3 Awards - $500, $300, $200 for Best Student Papers / Posters



May 1st, 2018

Boxboro Regency, Boxborough, Massachusetts

The New England Chapter Symposium Technical Program Committee seeks papers that demonstrate how new technologies and applications are expanding and redefining microelectronics. Areas of interests include:

Industry

- Biomedical Electronics
- Telecom - Microwave
- Military Electronics
- Consumer Electronics
- Renewable Energy: Fuel Cells, Solar, Wind
- Thermal Management
- Manufacturing, Outsourcing & Quality
- Solar/PV
- High Performance Interconnects and Boards
- Imaging Sensors
- Emerging Technologies

Advanced Processes & Materials

- 2.5 / 3D and High Density Packaging
- Photonic / Optoelectronic Packaging
- LED Packaging
- MEMS and Nano Packaging
- Underfill, Encapsulants, and Adhesives
- Green Packaging / Compliance with RoHS
- Flip-Chip and Bumping: Processes, Reliability
- Wirebonding and Stud Bumping
- Embedded and Integrated Passives
- Ceramic, Polymer and Conductive Materials
- Conformal Electronic Materials
- Wearable / Printed Electronics

Please send 250 word abstract to Jon Medernach – Jon.Medernach@mrsisystems.com
Or Send to: Abstracts@imapsne.org

Submission form and more details available at - www.imapsne.org

Deadline for Abstract Submission – December 31, 2017

EVENT CALENDAR

2017

June 15	**ASP 2017 | Vestal, NY** Advanced Technology Workshop on Advances in Semiconductor Packaging www.imaps.org/asp
June 27-29	**SiP 2017 | Sonoma, California** Inaugural Conference and Exhibition on System in Package Technology www.imaps.org/sip
July 10-12	**HiTEN 2017 | Cambridge, UK** International Conference and Exhibition on High Temperature Electronics www.imaps.org/hiten
October 9-12	**IMAPS 2017 | Raleigh, NC** 50th International Symposium on Microelectronics www.IMAPS2017.org
December 5-7	**3D ASIP 2017 | San Francisco, California** Conference on 3D Architectures for Semiconductor Integration and Packaging www.3DASIP.org

PLUS: Stay tuned for Additive Manufacturing and Thermal Management advanced technology workshop dates in Fall 2017!

2018

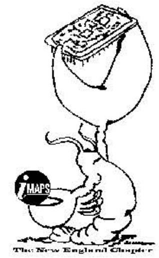
March 5-8	**Device Packaging 2018 | Scottsdale, AZ** 14th International Conference and Exhibition on Device Packaging
October 8-11	**IMAPS 2018 | Pasadena, CA** 51st International Symposium on Microelectronics

Visit www.IMAPS.org for event announcements and details!

"EARLYBIRD" EXHIBITOR REGISTRATION

iMAPS NEW ENGLAND'S 45th Symposium & Expo, May 1, 2018

At the Boxboro Regency, Boxborough, Massachusetts



Thank you for making our 44th Symposium & Expo a huge success.
We hope you found the Technical Program to be informative and educational, this is our goal!
Planning for SYMPOSIUM XLV has already begun...
The date has been set, The Boxborough location is excellent and...

NOW You can be an iMAPS New England EarlyBird!!

Reserve now to ensure your place in next year's show, save money $$$, and includes your listing on the chapter website and in all event publicity!
Plus, it gets our event off to an excellent head start.

Bring completed form to the iMAPS Booth at Big Red's Bistro – TODAY!!!
OR Register ON-LINE using the 2018 EarlyBird Link at www.imapsne.org
$550 Discounted Rate is Valid Until May 31, 2017 ONLY!!

No Payment is required now. We will bill you 3-4 months prior to The Symposium.

Our all-inclusive exhibition fee includes:

8' x 10' Carpeted Booth & Company Sign
Unlimited Exhibits Passes
Coffee & Hors d'oeuvres in Exhibit Hall
Your Logo & Link on The Chapter Website
List of Attendees

- PLUS -

One Full Symposium Registration with Admittance to all Technical Sessions, Lunch, Beverage Tickets, and Copy of the Symposium Proceedings

Print Clearly

*Company Name ______________________________
Company Sign in Booth (if different) ______________________________
*Company Address ______________________________
*City ____________________ *State __________ *Zip __________
*Phone ____________________ Fax ____________________
*Website URL ____________________ May we put a link on the chapter website? _____
*Exhibitor Registered Contact (Name on Badge) ______________________________
Company Name on Badge (if different) ______________________________
*E-Mail ____________________ Phone (if different) ____________________
Address (if different) ______________________________
City ____________________ State __________ Zip __________
*Exhibits Coordinator ______________________________
*Phone ____________________ *E-Mail ____________________
*Business or Product[s] ____________________ Check if Manufacturer's Rep ☐
Number of spaces requested _____ @ $550.00 each .... Total for Booth Space $ __________
Communications, Flyers, Exhibits Passes and Raffle information will be e-mailed to both persons listed above.
Comments or requests: ______________________________
*Required fields

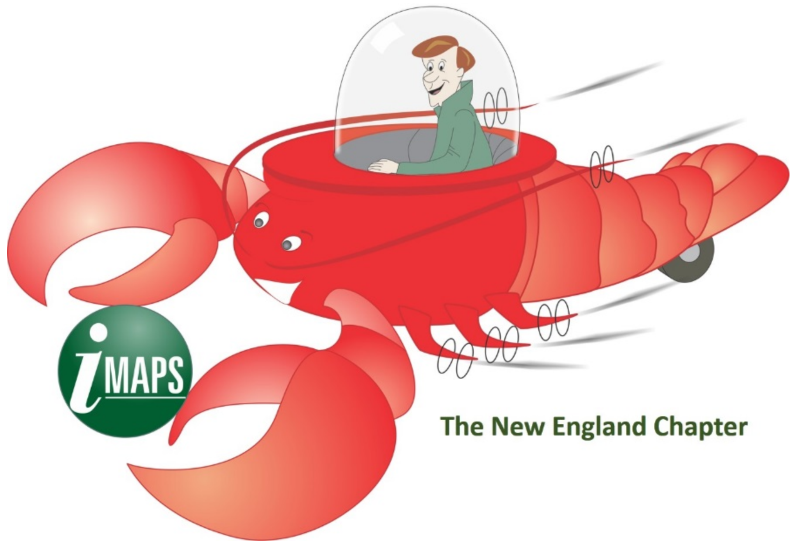
For more info contact Exhibits Chair, Michael Toro, AMETEK AEGIS, Michael.Toro@ametek.com (508) 425-6917

Remember to make frequent visits to our website: www.imapsne.org

The New England Chapter

On behalf of iMAPS New England…

We would like to graciously thank our Gold & Silver Sponsors for their continued support of our Foundation



MSI
MINI-SYSTEMS, INC.

MRSI SYSTEMS

Geib Refining Corp.
Dependable Precious Metal Reclamation

GREEN
TJ GREEN ASSOCIATES, LLC

STELLAR industries

TECHNIC INC

METALLIX REFINING INC