International Conference on Compound Semiconductor Manufacturing Technology

April 29th – May 2nd, 2019

www.csmantech.org

Hyatt Regency
Minneapolis, Minnesota, USA
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MESSAGE FROM THE CONFERENCE CHAIR

On behalf of the Executive and Technical Program Committees, it is my pleasure to welcome you to Minneapolis, MN for the 34th annual International Conference on Compound Semiconductor Manufacturing Technology (CS-MANTECH). From its inception in 1986, the CS-MANTECH conference has been the only conference dedicated to featuring manufacturing-focused presentations alongside state of the art compound materials challenges and industry-leading device performance demonstrations, all within a single venue. This year the conference continues this tradition, offering a diverse technical program in compound semiconductor manufacturing, advances in materials growth and characterization, and device performance improvements. This year’s program includes traditional elements attendees have come to expect, including RF devices, process control, reliability, manufacturing, and fabrication processes. In addition, the conference features strong talks in emerging areas, including GaN and other wide bandgap devices, heterogeneous integration, power devices, and optoelectronic devices. As chair of this year’s conference, I am gratified by the opportunity to help bring together compound semiconductor professionals from around the world to share information, exchange ideas, and establish professional ties within the community.

As with all previous CS-MANTECH conferences, this year’s conference would not be possible without a tremendous amount of work from many individuals who have volunteered their time to ensure its success. I would like to thank all of the volunteers on the Technical Program Committee and the Executive Committee, along with their supporting organizations. It is the work of these individuals that enables CS-MANTECH to provide its important service to the compound semiconductor industry.

I look forward to welcoming you in person to Minneapolis, and to a successful 2019 CS-MANTECH!

Patrick Fay
University of Notre Dame
Conference Chair
CONFERENCE AT A GLANCE

**SUNDAY, April 28th**

6:00 PM – 8:00 PM  REGISTRATION  
Nicollet Alcove D

7:00 PM – 9:00 PM  JEDEC JC-14.7 MEETING  
St. Croix (2nd floor)

**MONDAY, April 29th**

7:00 AM – 7:00 PM  CS MANTECH  
REGISTRATION  
Nicollet Alcove D

7:00 AM – 8:30 AM  ROCS REGISTRATION  
Nicollet Alcove A

7:00 AM – 8:30 AM  CS MANTECH & ROCS  
WORKSHOP BREAKFAST  
Nicollet D

8:15 AM – 5:15 PM  CS MANTECH WORKSHOP  
Nicollet B-C

8:30 AM – 5:00 PM  ROCS WORKSHOP  
Nicollet A

11:30 AM – 1:00 PM  CS MANTECH & ROCS  
WORKSHOP LUNCHEON  
Nicollet D

2:00 PM – 7:00 PM  SPEAKER PREPARATION/READY ROOM  
Grant Room

6:00 PM – 9:00 PM  EXHIBITS RECEPTION  
Exhibit hall

6:15 PM – 8:55 PM  EXHIBITOR FORUM  
Exhibit hall

**TUESDAY, April 30th**

7:00 AM – 5:00 PM  REGISTRATION  
Nicollet Alcove D

7:00 AM – 7:00 PM  SPEAKER PREPARATION/READY ROOM  
Grant Room

7:00 AM – 8:00 AM  BREAKFAST  
Exhibit hall

8:00 AM – 8:30 AM  OPENING CEREMONIES  
Nicollet A-C
TUESDAY, April 30th continued

8:00 AM – 5:30 PM  EXHIBIT HOURS
                    Exhibit hall

8:30 AM – 9:30 AM  SESSION 1: PLENARY
                    Nicotlet A-C

9:30 AM – 10:00 AM BREAK
                    Exhibit hall

10:00 AM – 12:00 PM SESSION 1: PLENARY
                    Nicotlet A-C

12:00 PM – 1:30 PM  EXHIBITS LUNCH
                    Exhibit hall

1:00 PM – 5:10 PM  EXHIBITOR FORUM
                    Exhibit hall

1:30 PM – 3:10 PM  SESSION 2: 5G
                    Nicotlet A

1:30 PM – 3:10 PM  SESSION 3: MANUFACTURING CULTURE
                    Nicotlet B-C

3:10 PM – 3:40 PM  BREAK
                    Exhibit hall

3:40 PM – 5:40 PM  SESSION 4: RF DEVICES AND FILTERS
                    Nicotlet A

3:40 PM – 5:40 PM  SESSION 5: GaAs PROCESS CONTROL & YIELD
                    Nicotlet B-C

5:45 PM – 6:45 PM  STUDENT FORUM
                    Lakeshore C

7:00 PM – 10:00 PM INTERNATIONAL RECEPTION
                    Minneapolis Institute of Art

WEDNESDAY, May 1st

6:00 AM – 7:00 AM  CS MANTECH RUN/WALK
                    Hyatt Regency Minneapolis
                    Loring Greenway Exit

7:00 AM – 5:00 PM  REGISTRATION
                    Nicotlet Alcove D

7:00 AM – 7:00 PM  SPEAKER PREPARATION/ READY ROOM
                    Grant Room
WEDNESDAY, May 1st continued

7:00 AM – 8:00 AM  BREAKFAST
Exhibit hall

8:00 AM – 11:00 AM EXHIBIT HOURS
Exhibit hall

8:00 AM – 10:00 AM SESSION 6: POWER ELECTRONICS PLENARY
Nicollet B-C

10:00 AM – 10:30 AM BREAK
Exhibit hall

10:30 AM – 12:00 PM SESSION 7: WIDE BANDGAP POWER DEVICES
Nicollet B-C

10:30 AM – 12:10 PM SESSION 8: HETEROGENEOUS INTEGRATION & PROCESSING
Nicollet A

12:15 PM – 1:30 PM OPEN
Lunch on your own with a little time to explore Minneapolis

1:30 PM – 3:20 PM SESSION 9: GaN LATERAL POWER DEVICES
Nicollet B-C

1:30 PM – 3:30 PM SESSION 10: DEVICE PROCESSING I
Nicollet A

3:30 PM – 4:00 PM BREAK
Nicollet Promenade

4:00 PM – 5:40 PM SESSION 11: TEST & CHARACTERIZATION – CS DEVICES
Nicollet B-C

4:00 PM – 5:40 PM SESSION 12: DEVICE PROCESSING II
Nicollet A

6:00 PM – 8:00 PM RUMP SESSIONS
Nicollet D & Lakeshore A-C

8:00 PM – 9:00 PM SEMI STANDARDS MEETING
St. Croix (2nd floor)
THURSDAY, May 2nd

7:00 AM – 9:30 AM  REGISTRATION
Nicollet Alcove D

7:00 AM – 12:00 PM  SPEAKER PREPARATION/READY ROOM
Minnehaha Room (2nd Floor)

7:00 AM – 8:00 AM  BREAKFAST
Nicollet D

8:00 AM – 10:00 AM  SESSION 13: OPTOELECTRONICS PLENARY
Nicollet B-C

10:00 AM – 10:30 AM  BREAK
Nicollet Promenade

10:30 AM – 12:20 PM  SESSION 14: VCSEL
Nicollet B-C

10:30 AM – 12:10 PM  SESSION 15: TEST & CHARACTERIZATION OF WIDE BANDGAP HETEROSTRUCTURES
Nicollet A

12:20 PM – 1:30 PM  CS MANTECH LUNCH
Nicollet D

1:30 PM – 3:30 PM  SESSION 16: PROCESS AND YIELD
Nicollet B-C

1:30 PM – 3:30 PM  SESSION 17: MATERIALS AND GROWTH FUNDAMENTALS
Nicollet A

3:40 PM – 4:30 PM  SESSION 18: POSTER SESSION
Lakeshore ballroom

4:30 PM – 5:30 PM  CLOSING RECEPTION
Lakeshore ballroom

6:00 PM – 8:00 PM  CoInnovateCS Networking Reception
https://www.coinnovatecs.com

FRIDAY, May 3rd

8:00 AM – 8:30 AM  CoInnovateCS Registration

8:30 AM – 1:15 PM  CoInnovateCS
https://www.coinnovatecs.com

2019 CS MANTECH Conference Guide 7
2019 CONFERENCE HIGHLIGHTS

On behalf of the Technical Program Committee for the 2019 CS MANTECH Conference, I thank you for participating in this year’s program. We have an excellent conference planned and I am sure you will find many enlightening and informative talks and sessions for your enjoyment and edification.

CS MANTECH has its roots in the application of compound semiconductors for RF devices. This year we broaden the scope beyond RF into other compound semiconductor markets and are introducing a plenary session for each day. On Tuesday we will have a classic CS MANTECH plenary session. On Wednesday we will have our first dedicated CS MANTECH Power electronics plenary session followed by our CS Optoelectronic plenary session on Thursday. Both dedicated plenary sessions are comprised of a keynote and invited talks.

Another new feature this year is that we are co-located with CoInnovateCS (https://coinnovatecs.com) which is being held in the US for the first time. CoInnovateCS promises to offer an interactive one day event fostering innovation across the compound semiconductor supply chain, by exploring industry-led next generation challenges and opportunities.

Here are the highlights for the program:

**Sunday, April 28th**
- This year we are introducing our first CS MANTECH golf outing (weather permitting). More details can be found on our website and mobile app. Please check in frequently.

**Monday, April 29th**
- The program begins this year with our series of tutorial workshops. This year’s workshop theme is “Fabrication Potpourri.” Please see the CS MANTECH WORKSHOP section for details.
- Also, on Monday CS MANTECH is pleased to be hosting the internationally recognized Reliability of Compound Semiconductor (ROCS) workshop. This workshop is the premier forum for the presentation of the latest results and new developments related to compound semiconductor reliability. The JEDEC Committee JC-14.7 sponsors the ROCS workshop. Please see http://www.jedec.org/home/gaas for details.
- On Monday evening, the Exhibits open at 6:00 pm with the traditional Exhibits Reception. The CS MANTECH exhibits are an excellent opportunity to view suppliers of materials, services, and equipment from around the world. This is also a great time to reconnect with your friends and establish new
connections to identify new opportunities and help grow your success.

- At 6:15pm we will open the Exhibitor forum in the Exhibit hall. The Exhibitors’ Forum provides an opportunity for exhibitors to present short marketing/technical presentations to the conference attendees.

Tuesday, April 30th

- The CS MANTECH Conference formally begins in the morning at 8:00 am with opening ceremonies that include the 2018 Best Paper awards, sponsorship recognition, and a conference overview along with a review of the conference mobile app. Please see the mobile app section for details.

- Following the opening ceremonies, we will have our traditional plenary session, which features three talks covering a wide spectrum of CS Industry topics. Tom Deitrich from Itron will give his perspective on the solutions and needs of IoT, utilities, and smart cities. Wayne Lam from IHS Markit will reflect on how mobile use cases dictates electronic design and Andrew Barnes from the European Space Agency will report on the first ESA missions to use gallium nitride (GaN).

- After lunch in the Exhibits Hall, we will reconvene for a full program of parallel sessions throughout the afternoon. Parallel sessions have been structured so that attendees can move between talks and sessions, with minimal overlap between the parallel sessions.

- We will also continue our Exhibitor forum in the Exhibit hall throughout the afternoon.

- The Tuesday technical session will conclude with the Student Forum. The Student Forum provides an opportunity for students to explore career options through networking with members of the CS community from industry, academia, and government.

- In the evening, CS MANTECH will host the International Reception (IR) at the Minneapolis Institute of Art. This annual event has been a fun and memorable highlight of past conferences and we anticipate an exciting evening again this year.

Wednesday, May 1st

- For a mid-week rejuvenator, join us in the morning at 6:00 am for a non-competitive run or walk along the Loring Greenway through Loring Park. More details can be found on our website.

- Wednesday morning begins with breakfast in the Exhibitor Hall where attendees can follow up on questions from the Exhibitors’ Forum or meet with one or two new vendors.

- We will open the technical program on Wednesday with our first dedicated Power Electronics plenary at 8:00 am. John Palmour from Wolfspeed will focus on
the current status of SiC materials and devices for use in power applications. Dr. Koji Shiozaki from Nagoya University will present a new mobility concept called all GaN vehicles (AGV), and Dr. Frank Wischmeyer from Aixtron reviews the latest developments of epitaxy production technology for SiC and GaN.

- Following the morning break, a full program of parallel sessions will take place throughout the day.
- Lunch will be at your own leisure (or time to explore Minneapolis), with parallel sessions continuing in the afternoon starting at 1:30 pm.
- We will close the day with our traditional Rump session starting at 6:00 pm with a reception. Please see the Rump Session section for details.
- At 8:00 pm the SEMI Standard Meeting will be held.

**Thursday, May 2nd**

- On Thursday, we will open the technical program with our first dedicated Optoelectronics plenary at 8:00 am. Chuck Mattera from II-VI will provide an overview and perspective on vertical-cavity-surface-emitting-lasers (VCSELs). Fred Kish of Infinera Corporation will discuss key elements of success for volume manufacturing of InP based photonic integrated circuits, and Eric Virey of Yole Développement will present on the hype, reality, hopes and challenges of MicroLED displays.
- Following the morning break, we will continue with parallel sessions.
- At noon, all conference attendees are invited to join us for the CS MANTECH conference luncheon.
- After lunch, we will hold our last two parallel sessions followed by the poster session. The closing reception features prizes for the conference contest (best semiconductor joke or meme), as well as for best poster and conference feedback. We will also have a special guest, John DeBoer (http://www.johndeboer.com). Come see the posters, join the contest, and enjoy our conference closing reception.
- CoInnovateCS open its doors at 6:00pm (please see https://coinnovatecs.com for more details and registration information)

Thank you again for being part of this year’s conference and welcome to Minneapolis!

**Thorsten Saeger**  
Qorvo  
Technical Program Chair  
2019 CS MANTECH
2019 CONFERENCE SPONSORS

CS MANTECH is an independent not-for-profit organization whose mission is to promote technical discussion and scientific education in the compound semiconductor manufacturing industry. The continued success of the conference is enabled by donations from corporate sponsors. The 2019 CS MANTECH Conference Committee gratefully acknowledges the support from our sponsors.

(Sponsor list confirmed at time of printing)

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The theme of this year’s workshop is “Fabrication Potpourri”.

The technology that we use and produce in our day-to-day work lives is constantly changing. This year’s workshop will take some time to refresh some basic skills and knowledge of value to the semiconductor engineer and also look forward to opportunities for the industry.

The morning talks will focus on changing trends in semiconductor foundry operations and process optimization. The first talk comes from SkyWater Technology Foundry. Tom Legere, the Senior Vice President of Operations, will discuss how to manage a high mix technology foundry in the age of “more than Moore.” The following extended talk from Joseph Holyoak at Qorvo will provide an overview of Six Sigma (6σ) practices describing how statistical analysis and proper design of experiments (DOEs) can be used for process optimization and to ensure high quality of output.

Shifting focus, the afternoon workshop talks will begin with discussions on emerging opportunities for the compound semiconductor industry. Michael O’Neal, Senior Director of Design and Advanced Engineering at Qorvo, will provide an overview of 5G networks and the role compound semiconductor technologies can play. The next workshop talk comes from Dr. Dennis Deppe of sdPhotonics in which he will discuss vertical-cavity surface-emitting lasers (VCSELs). Various VCSEL technologies will be described along with market drivers and applications.

Following the afternoon break, the final talk of the day will be jointly presented with the Reliability of Compound Semiconductors (ROCS) workshop. Dr. Mike Salmon, a Scientific Fellow from EuroFins-EAG, will discuss destructive physical analysis (DPA) describing various imaging and analytical techniques. Methodologies for determination of underlying root cause in unique failures addressed through multi-technique case studies will be presented.
2019 ROCS WORKSHOP

Reliability of Compound Semiconductors

Monday, April 29th, 2019
8:30 AM – 5:00 PM

The 35th annual ROCS Workshop will be held in conjunction with the CS MANTECH Conference on Monday April 29th, 2019, at the Hyatt Regency Minneapolis in Minneapolis, Minnesota, USA. This workshop is sponsored by the JEDEC JC-14.7 Committee on GaAs Reliability and Quality Standards. The ROCS Workshop brings together researchers, manufacturers and users of compound semiconductor materials, devices and circuits. Papers presenting latest results, including work-in-progress and new developments in all aspects of compound semiconductor reliability will be presented.

2019 CoInnovateCS

Friday, May 3rd, 2019
8:00 AM – 1:15 PM

Held in the US for the first time and co-located with CS-MANTECH in Minneapolis, CoInnovateCS provides a unique opportunity to collaborate with experts in compound semiconductor manufacturing. CoInnovateCS is a unique and intense interactive one day event fostering innovation across the compound semiconductor supply chain, by exploring industry-led next generation challenges and opportunities. This year’s CoInnovateCS event will focus on emerging trends across the compound semiconductor industry. The conference promises an agenda with engaging activities, including inspirational talks, panel sessions, technology pitches and CoSynergy workshops where we will explore challenges and opportunities in a more innovative and collaborative way. More details can be found online: https://coinnovatecs.com/
INDUSTRY EXHIBITS

2019 will continue the CS MANTECH tradition of holding a robust exhibits program in parallel with the technical conference to facilitate interactions and exchange amongst members of the compound semiconductor industry. Exhibitors spanning the full range of materials, equipment, and services relevant to the compound semiconductor industry will be on hand to interact with conference attendees. Vendors of substrates, process gas and specialty material suppliers, fabrication, inspection and test equipment providers, technical and manufacturing consulting services, and industrial publication venues will be there.

To facilitate interactions between exhibitors and attendees, an Exhibits Reception will be held on Monday evening, April 29th, in the exhibition hall. The exhibits will also be open all day Tuesday, April 30th through Wednesday morning, May 1st until 11:00 AM, with breakfasts, coffee breaks, and lunch on Tuesday during the conference all taking place in the exhibition hall. Additionally, a series of Exhibitor Forum events will take place on Monday from 6:15 PM – 8:55 PM and Tuesday from 1:00 PM to 5:10 PM in the Exhibit Hall. These events provide participating exhibitors an opportunity to more fully showcase their products and services.

2019 EXHIBITORS

ABLEtech
Accel-RF
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Reedholm Systems
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Samco, Inc.
Semilab
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SPTS Technologies
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Sumitomo Chemical Advanced Technologies
Toho Technology
ULVAC, Inc.
Vacuum Engineering & Materials
Veeco
Virginia Diodes Inc.
Visual Photonics Epitaxy Co., Ltd
Vital Materials Co., Limited
Wafer World Inc.
Wolfspeed, A Cree Company
Yield Engineering Systems, Inc.

EXHIBITOR FORUM SCHEDULE

MONDAY, April 30th, 2019
Location: Exhibits Hall

6:15 PM to 6:25 PM Wolfspeed
6:30 PM to 6:40 PM Canon USA
6:45 PM to 6:55 PM Bruker Semiconductor
7:00 PM to 7:10 PM EpiGaN
7:15 PM to 7:25 PM Evatec
7:30 PM to 7:40 PM ANNEALSYS
7:45 PM to 8:00 PM Fujimi Corp
8:00 PM to 8:40 PM DISCO Hi-Tec
8:45 PM to 9:05 PM Inspectrology LLC
9:10 PM to 9:40 PM Beneq
9:45 PM to 10:15 PM LayTec
EXHIBITOR FORUM SCHEDULE
(Continued)

TUESDAY, May 1st, 2019
Location: Exhibits Hall

1:00 PM to 1:10 PM AIXTRON
1:15 PM to 1:25 PM EAG Laboratories
1:30 PM to 1:40 PM GT Advanced Technologies
1:45 PM to 1:55 PM II-VI Advanced Materials
2:00 PM to 2:10 PM ePak
2:15 PM to 2:25 PM PlasmaTherm
2:30 PM to 2:40 PM Evatec
2:45 PM to 2:55 PM SPTS Technologies
3:00 PM to 3:10 PM Revasum
3:15 PM to 3:25 PM Samco
3:30 PM to 3:40 PM Yield Engineering Systems
3:45 PM to 3:55 PM Nanotronics
4:00 PM to 4:10 PM Nel Hydrogen
4:15 PM to 4:25 PM Oxford Instruments

INTERNATIONAL RECEPTION

On Tuesday, April 30th evening, CS MANTECH will host
the International Reception. This annual event has been a
fun and memorable highlight of past conferences and we
anticipate an exciting evening again this year. This year the
International Reception will be held at the Minneapolis
Institute of Art (MIA). Join us to socialize with your
colleagues and experience diverse art from around the
world. (https://new.artsmia.org/).

CS MANTECH CONFERENCE CONTEST

The conference contest this year will test both your wit
and semiconductor knowledge. The goal is to submit your
best (clean) semiconductor meme or joke. The best entry
wins a prize and is shared at the conference closing. Good
luck!

2019 CS MANTECH ONLINE DIGEST

CS MANTECH will again be offering an online digital
version of the conference technical proceedings. Digital
copies of the papers presented at the 2019 International
Conference on Compound Semiconductor Manufacturing
Technology will be available for download and viewing
from our online site during the conference. Printed 2019
digests were offered to attendees who requested a copy at
the time of conference registration and if registration was
completed by the early registration deadline, April 5th.

To access the 2019 online digest, go to to
www.csmantech.org and click on “2019 Online Digest”.

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SEMI STANDARDS MEETING

The SEMI Standards meeting is scheduled for Wednesday May 1st, from 8:00 pm to 9:00 pm in the St. Croix meeting room on the 2nd floor. The SEMI Compound Semiconductor (GaAs, InP and SiC) Committee invites CS MANTECH Conference attendees interested in the development of internationally approved standards for wafer specifications to attend this meeting. Topics being addressed are GaAs, InP, and SiC dimensions/orientations and electrical properties, epitaxial layer specifications (which properties should be specified, and how they are to be verified), and non-destructive test methods.

Based in Milpitas, CA, SEMI is an international trade association serving more than 2,400 companies participating in the semiconductor and flat panel display equipment and materials markets. SEMI maintains offices in Berlin, Grenoble, Tokyo, Seoul, Hsinchu, Shanghai, Singapore, Bangalore, and Washington, DC. For additional information, please contact: Co-Chair: James Oliver of Northrop Grumman at 410-765-0117 or j.oliver@ngc.com, Co-Chair: Russ Kremer of Freiberger Compound Materials at 937-291-2899 or russ@fcm-us.com, or at SEMI Standards contact Kevin Nguyen at 408-943-7997 or knguyen@semi.org.
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Andy Souzis, II-VI Advanced Materials
Joerg Spießtstoesser, United Monolithic Semiconductor GmbH
Christopher Stender, MicroLink Devices, Inc.
Kevin Stevens, IQE
Susan Stevens, Analog Devices, Inc.
Eric Stewart, Northrop Grumman
Hermann Stiegauer, United Monolithic Semiconductor GmbH
Mike Sun
Jim Tatum, Photon Sciences
Shiban Tiku, Skyworks Solutions
Naveen Tipirneni, Texas Instruments
Matthew Tyhach, Raytheon
Jansen Uyeda, Northrop Grumman
Kevin Vargason, IntelleEPI
Glen “David” Via, Air Force Research Laboratory
David Wang, Global Communication Semiconductors, LLC
Russ Westeran, Plasma-Therm LLC
Keith Wieber, Qorvo
Walt Wohlmuth, Win Semiconductors Corp.
Barry Wu, Keysight Technologies
Takuji Yamamura, Sumitomo Electric
Wei Zhang, AXT
Guoliang Zhou, Skyworks Solutions
Heribert Zull, OSRAM Opto Semiconductors GmbH
TECHNICAL PROGRAM

Monday, April 29th

CS MANTECH WORKSHOP
“Fabrication Potpourri”

Location: Nicollet B-C
Chairs: Gerhard Schoenthal, Virginia Diodes
        Glen “David” Via, Air Force Research Laboratory

7:00 AM REGISTRATION
7:30 AM WORKSHOP BREAKFAST
7:50 AM WELCOME AND INTRODUCTIONS
8:00 AM Making Moore Happen: Managing a High Mix Technology Foundry
        Tom Legere, SkyWater Technology Foundry
9:00 AM 6σ – What it is and how to use it
        Joseph Holyoak, Qorvo
10:00 AM BREAK
10:30 AM 6σ – What it is and how to use it
        (continued)
        Joseph Holyoak, Qorvo
12:00 PM WORKSHOP LUNCH
        (CS MANTECH & ROCS)
1:00 PM 5G: Changing the way we work, live and play
        Michael K O’Neal, Qorvo
2:00 PM Oxide and Oxide-Free VCSELs for High Market Volume Manufacturing and New Applications
        Dennis Deppe, sdPhotonics LLC
3:00 PM BREAK
3:30 PM Advanced Failure Analysis of Compound Semiconductors
        Mike Salmon, EuroFins-EAG
4:30 PM WRAP UP
6:00 PM EXHIBITS RECEPTION
Monday, April 29th

ROCS WORKSHOP

Location: Nicollet A
Chair: Don Gajewski, Wolfspeed, A Cree Company

7:30 AM ROCS REGISTRATION
7:30 AM WORKSHOP BREAKFAST
8:30 AM Welcome & Opening Remarks
8:40 AM ROCS Session 1: GaN Voltage Stress Testing
10:30 AM ROCS Session 2: GaN Qualification Testing
12:00 PM WORKSHOP LUNCH (CS MANTECH & ROCS)
1:00 PM ROCS Session 3: CS Reliability Potpourri
2:00 PM Tutorial – GaN Reliability Testing
   David Sanderlin, Accel-RF
3:00 PM ROCS Shocks! Photo Contest
3:30 PM Combined ROCS/CS MANTECH Talk:
   Advanced Failure Analysis of Compound Semiconductors
   Mike Salmon, EuroFins-EAG
4:30 PM WRAP UP
6:00 PM EXHIBITS RECEPTION
**Tuesday, April 30th**

**CONFERENCE OPENING**
Location: Nicollet A-C

8:00 AM  **Opening Ceremonies**  
Patrick Fay, Conference Chair  
*University of Notre Dame*

8:10 AM  **2018 Conference Best Paper Awards**  
Patrick Fay, Conference Chair  
*University of Notre Dame*

8:20 AM  **Technical Program Highlights**  
Thorsten Saeger, Technical Program Chair  
*Qorvo*

**SESSION 1: PLENARY**
Location: Nicollet A-C  
Chairs: Patrick Fay, *University of Notre Dame*  
Thorsten Saeger, *Qorvo*

8:30 AM  **Invited Presentation**  
1.1 A Perspective on the Solutions and Needs of IoT, Utilities, and Smart Cities  
Tom Detrich  
*Itron*

9:30 AM  **BREAK**

10:00 AM  **Invited Presentation**  
1.2 Form follows function: Mobile use-cases dictate electronic design, not the other way around  
Wayne Lam  
*HIS Markit – Technology, Media & Telecom*

11:00 AM  **Invited Presentation**  
1.3 First ESA missions to use gallium nitride (GaN) – a disruptive technology for space based payloads  
Andrew Barnes  
*European Space Agency*

12:00 PM  **EXHIBITS LUNCH**  
*Exhibits Hall*
Tuesday, April 30th

SESSION 2: 5G
Location: Nicollet A
Chairs: Takuji Yamamura, Sumitomo Electric
Yogi Ota, Duet RF Solutions

1:30 PM Invited Presentation
2.1 5G Implications for the Compound Semiconductor Industry
Earl J. Lum
EJL Wireless Research LLC

2:00 PM Invited Presentation
2.2 How Will 5G Influence the RF Compound Semiconductor Industry?
Eric Higham
Strategy Analytics

2:30 PM 2.3 Development of InP DHBTs with High Breakdown Voltage for Ka-Band PA Applications
Yuefei Yang¹, Dheeraj Mohata¹, David Rasbot¹, R. Soligo², David Wang¹,
Robert Bayruns², John Bayruns², David Osika² and Joseph Brand²
¹Global Communication Semiconductors, LLC.
²Duet Micro Electronics, Inc.

2:50 PM 2.4 5G impact on mobile RF Front End
Ezgi Dogmus, Cédric Malaquin and Claire Troadec
Yole Développement

3:10 PM BREAK
Tuesday, April 30th

SESSION 3: MANUFACTURING CULTURE
Location: Nicollet B-C
Chairs: Keith Wieber, Qorvo
Sarang Kulkarni, Skyworks Solutions

1:30 PM Invited Presentation
3.1 Complexity vs. Continuous Process Improvement
Gad (Gadi) Dvir
Strategy Implementation LLC Managing Member

2:00 PM 3.2 Fast Throughput Improvement Through Speed Modeling Using Tool Matching and Process Optimization
Marino Arturo
The MAX Group

2:20 PM 3.3 Improving Root Cause Analysis Accuracy Using Advanced Sensor Trace Analytics
Michael Zhao¹, Kim Kok Gan²
¹Global Foundries, ²BISTel America

2:40 PM Invited Presentation
3.4 Implementation of Automated Process Dashboards
Jens Riege, Donnie Lee, Rainier Lee, Nercy Ebrahimi
Skyworks Solutions, Inc.

3:10 PM BREAK
Tuesday, April 30th

SESSION 4: RF DEVICES AND FILTERS

Location: Nicollet A
Chairs: Haldane Henry, Qorvo
Serge Karboyan, University of Bristol

3:40 PM Invited Presentation
4.1 Dynamic Range-enhanced Electronics and Materials
Young-Kai Chen¹, Tsu-Hsi Chang², Abirami Sivananthan³
¹Defense Advanced Research Projects Agency,
²HedInTec Corp.
³Booz Allen Hamilton

4:10 PM
4.2 Investigation of RF Performance of InGaP/GaAs HBT Power Stage with Flip-Chip Bumping Technology
Fan-Hsiu Huang, Jung-Hao Hsu, Tung-Yao Chou, Shu-Hsiao Tsai, Cheng-Kuo Lin, Dennis Williams, and Yu-Chi Wang
WIN Semiconductors Corp.

4:30 PM Invited Presentation
4.3 Epitaxial material for RF filters
Andrew Clark¹, Rytis Dargis¹, Mukul Debnath¹, Robert Yanka¹, Rich Hammond², Rodney Pelzel¹, Mingyo Park³, Azadeh Ansari⁴
¹IQE NC
²IQE Silicon
³IQE PA
⁴Georgia Institute of Technology

5:00 PM
4.4 Monolithic integration of surface acoustic wave (SAW) filters on GaN HEMT dies: Avoiding impedance matching through energy trapping
Stefano Valle¹, Manikant Singh², Martin Cryan¹, Martin Kuball², and Krishna C. Balram¹
¹University of Bristol
²Centre for Device Reliability and Thermography, University of Bristol

5:20 PM Student Presentation
4.5 High-quality AlN/sapphire-based Surface Acoustic Wave Filter With 5.75 dB Insertion Loss
Qiong Feng¹, Yun Zhang¹, Shuai Yang¹, Yujie Ai¹, Zhe Cheng¹, Lian Zhang¹, Lifang Jia¹, Boyu Dong², Baohui Zhang²
¹Institute of Semiconductors, Chinese Academy of Sciences
²NAURA Technology Group Co., Ltd
Tuesday, April 30th

SESSION 5: GaAs PROCESS CONTROL & YIELD
Location: Nicollet B-C
Chairs: Marty Brophy
        Susan Stevens, Analog Devices, Inc.

3:40 PM  5.1 High-Volume pHEMT Yield Improvement Through Mitigation of Incomplete Removal of InGaP
Robert Waco, Yiping Wang, Chang’e Weng,
David Punsalan, Ron Herring
Qorvo

4:00 PM  5.2 A Systematic Data Mining Approach to separate Epitaxial Impacts from Process Impacts for GaAs pHEMT Technologies
Peter Gretz, Franck Bourgeois, and Michael Hosch
United Monolithic Semiconductors GmbH

4:20 PM  5.3 Modelling of Backside-induced ESD Defects in GaAs Front End Manufacturing
Michael Hosch, Raphael Ehbrecht, Markus Lanz, Holger Weiner, and Dag Behammer
United Monolithic Semiconductors GmbH

4:40 PM  5.4 Addressing 0.25 um T-Gate Lithography Defects through Data Driven Fit Model Analysis
Monique Farrell, Kai Shin, Brittany Janis,
Kevin Frey, John Mason, Gary Hughes,
Christopher Ridpath, Megan Snook, Aditya Gupta, H. George Henry, David Lawson,
Jim Arnold, Josephine Chang, Eric Seabron
Northrop Grumman Corporation

5:00 PM  5.5 Gold Electroplating Optimization in Diffusion-Limited Regime
Vinh Ho, Justin van Staden, Rainier Lee and Daniel Weaver
Skyworks Solutions, Inc.

5:20 PM  5.6 Investigation of MIM Top Metal Peeling in Relation to Transitional Flow during Metal Deposition Process
Chang’e Weng, Tertius Rivers, Moreen Minkoff, Ron Herring, Richard Ducusin,
Jinhong Yang and Joseph Chinn
Qorvo

5:45 PM  STUDENT FORUM

7:00 PM  INTERNATIONAL RECEPTION
Minneapolis Institute of Art
Wednesday, May 1st

SESSION 6: POWER ELECTRONICS PLENARY

Location: Nicollet B-C
Chairs: Naveen Tipirneni, Texas Instruments
       Martin Kuball, University of Bristol

8:00 AM Invited Presentation
6.1 Current Status of SiC Materials and Devices for use in Power Applications
John Palmour
Wolfspeed, A Cree Company

9:00 AM Invited Presentation
6.2 GaN-based Electrified Mobility for Sustainable Society
Koji Shiozaki1, Y. Nakayama1, Y. Kanazawa2
1Nagoya University, 2Naturanix Co.

9:30 AM Invited Presentation
6.3 Epitaxy production technologies enabling next generation product roadmaps of wide band-gap semiconductor device industry
Frank Wischmeyer
AIXTRON SE

10:00 AM BREAK

SESSION 7: WIDE BANDGAP POWER DEVICES

Location: Nicollet B-C
Chairs: Don Gajewski, Wolfspeed, A Cree Company
       Martin Huber, Infineon Technologies Austria AG

10:30 AM Invited Presentation
7.1 Advances in Vertical GaN Power Devices on GaN Substrates
K. Yasunishi, G. Nishio, S. Murakami, and N. Murakami
TOYODA GOSEI Co., Ltd.

11:00 AM Invited Presentation
7.2 Accelerating Commercialization of Wide-Bandgap Power Electronics – The Power America Manufacturing Initiative
Victor Veliadis
North Carolina State University
Wednesday, May 1st

11:30 AM Invited Presentation
7.3 SiC Power MOSFET Manufacturing, Performance and Reliability for the Electric Vehicle Market
Wolfspeed, A Cree Company

SESSION 8: HETEROGENEOUS INTEGRATION AND PROCESSING
Location: Nicollet A
Chairs: Hermann Stiegauer, United Monolithic Semiconductor GmbH
Greg Mills, AXR

10:30 AM 8.1 Layer transfer of high-voltage, GaN-on-GaN pn diodes through epitaxial lift-off
Chris Youtsey¹, Robert McCarthy¹, Rekha Reddy¹, Andy Xie², Ed Beam², Lou Guido², Jingshan Wang³, and Patrick Fay⁴
¹MicroLink Devices, Inc, ²Qorvo, ³Virginia Tech, ⁴University of Notre Dame

10:50 AM Invited Presentation
8.2 Heterointegration of III-V Device Structures on Si Substrates via Direct MBE Growth
A. W. K. Liu¹, D. Lubyshev¹, J. M. Fastenua¹, M. Fetters¹, H. Krysiak¹, J. Zeng¹, M. Kattner¹, P. Frey¹, S. A. Nelson¹, X.-M. Fang¹, A. O. Morgan¹, S. A. Edwards¹, and M. J. Furlong¹
¹IQE PA, ²IQE Silicon, ³IQE IR

11:20 AM 8.3 GaN quasi-MMIC HPAs with IPDs on HRS using via first TSV process
Sangmin Lee, Seokgyu Choi, Ho Geun Lee, Sung Won Lee, Young Jae Kim, Min Han, and Jimman Jin
Wavice Inc.

11:40 AM Invited Presentation
8.4 CMP Process Development on III-V Substrates for 3D Heterogeneous Integration
Miguel Urteaga¹, Andrew Carter¹, Sangki Hong², Robert Patti², Carl Petteway², Gill Fountain²
¹Teledyne Scientific & Imaging, ²NHanced Semiconductors Inc.

12:15 PM OPEN - Lunch on your own
Wednesday, May 1st

SESSION 9: GaN LATERAL POWER DEVICES

Location: Nicollet B-C
Chairs: Nicholas Della, Texas Instruments
        Mitsuhiro Nakamura, Sony

1:30 PM Invited Presentation
9.1 AlGaN/GaN Power Devices in a Si World: From R&D to Manufacturing and Reliability
P. Moens, P. Kostelnik and A. Constant
ON Semiconductor

2:00 PM
9.2 Demonstration of GaN-on-silicon material system operating up to 3 kilovolts with reduced trapping effects
R. Kabouche1, I. Abid1, M. Zegaou1, K. Cheng2, and F. Medjdoub1
1IEM-CNRS, 2Enkris Semiconductor

2:20 PM
9.3 Process Development Enabling Lateral GaN JFET Devices for Robust Power Switching on 200 mm Engineered Substrates
Travis J. Anderson1, James C. Gallagher2, Geoffrey M. Foster1, Andrew D. Koehler1, Marko J. Tadjar1, Ozgur Aktas3, Vladimir Odnoblyudov2, Cem Basceri1, Karl D. Hobart1
1U.S. Naval Research Laboratory, 2ASEE Postdoctoral Fellow Residing at NRL, 3Qromis, Inc.

2:40 PM Student Presentation
9.4 Improved Dynamic ON-resistance of a Normally Off p-GaN Gate High-Electron-Mobility Transistor Using a Nongated-Region Oxidation Technique
Chia-Hao Liu1, Hsuan-Ling Kao1, Hsien-Chin Chiu1, Yi-Sheng Chang1, Hao-Yu Wang1, Chao-Wei Chiu1, Hsiang-Chun Wang1, Chong Rong Haung1, Xin-ke Liu2
1Chang Gung University, 2Shenzhen University

3:00 PM Student Presentation
9.5 Low Interface Noise of p-GaN Gate Normally-off HEMT with Microwave Ohmic Annealing Process
Yi-Sheng Chang1, Chia-Hao Liu1, Chi-Chuan Chiu1, Hsiang-Chun Wang1, Hsien-Chin Chiu1, Rong Xuan2 and Chih-Wei Hu2
1Chang Gung University, 2Episil-Precision Inc.
**Wednesday, May 1st**

**SESSION 10: DEVICE PROCESSING I**

**Location:** Nicollet A  
**Chairs:** Thomas Roedle, Ampleon  
Walter Wohlmuth, WIN Semiconductors Corp.

1:30 PM **Invited Presentation**  
10.1 Process Optimization for Improved Adhesion of Ti/Pt/Au to SiN and GaAs  
Ganesh Dindukurthi, Yashwanth Konakalla, Carl Miester, David Troy, Prasanta Modak  
TRUMPF Photonics Inc.

2:00 PM **Invited Presentation**  
10.2 Damage-less Wet Etching for Normally-off AlGaN/GaN HEMTs using Photo-electrochemical Reactions  
Taketomo Sato, Keisuke Uemura, and Masachika Toguchi  
Research Center for Integrated Quantum Electronics, Hokkaido University

2:30 PM **10.3 Fabrication of Gallium Nitride Deep-Trench Structures by Photoelectrochemical Etching**  
Fumimasa Horikiri1, Hiroshi Ohta2, Naomi Asai2, Yoshinobu Narita1, Takehiro Yoshida1, and Tomoyoshi Mishima2  
1SCIOCS, 2Hosei University

2:50 PM **10.4 Development of Advanced Lift Off Processes for 5G and VCSEL Applications**  
Phillip Tyler1, Jonathan Fijal1, Kenji Nulman1, Anil Vijayendran1, David Rennie2, Jennifer Rieker3, Alberto Dioses2, John Zook2, John Sagan2, Phil Greene3, Shihu Deng3, Laura Mauer3  
1Veeco Instruments, 2EMD Performance Materials, 3Ferrotec Corporation

3:10 PM **10.5 Backside Processing of RF GaN-on-GaN HEMTs Considering Thermal Management**  
Fujitsu Limited and Fujitsu Laboratories Ltd.

3:30 PM **BREAK**
Wednesday, May 1st

SESSION 11: TEST & CHARACTERIZATION – CS DEVICES

Location: Nicollet B-C
Chairs: Anita Pacheco, Qorvo.
       Randy Lewis, Northrop Grumman Corp.

4:00 PM  Invited Presentation
11.1 Application-Specific, Comprehensive Technology and Product Qualification of GaN on Silicon Power Conversion Devices
Timothy McDonald
Infineon Americas Corporation

4:30 PM  Invited Presentation
11.2 Channel temperature determination for GaN HEMT lifetime testing – Impact of package and device layout
Filip Gucmann, James W. Pomeroy, Andrei Sarua, and Martin Kuball
Center for Device Thermography and Reliability (CDTR), University of Bristol

4:50 PM  Student Presentation
11.3 Extreme Temperature Operation of Ultra-Wide Bandgap AlGaN High Electron Mobility Transistors
P. H. Carey IV\textsuperscript{1}, F. Ren\textsuperscript{1}, A. G. Baca\textsuperscript{2}, B. A. Klein\textsuperscript{2}, A. A. Allerman\textsuperscript{2}, A. M. Armstrong\textsuperscript{2},
E. A. Douglas\textsuperscript{2}, R. J. Kaplar\textsuperscript{2}, S. J. Pearton\textsuperscript{1}
\textsuperscript{1}University of Florida
\textsuperscript{2}Sandia National Laboratories

5:10 PM  Invited Presentation
11.4 JEDEC Guidelines and Standards for Compound Semiconductors
Donald A. Gajewki
Wolfspeed, A Cree Company
Wednesday, May 1st

SESSION 12: DEVICE PROCESSING II

Location:  Nicollet A
Chair:  Corey Nevers, Qorvo

4:00 PM  12.1 Elimination of Metal Fencing by Optimizing Evaporator Dome Alignment
Kezia Cheng
MACOM Technology Solutions

4:20 PM  12.2 The State-of-Art of GaN/Diamond HEMT Manufacturing Technology and Device Performance
Daniel Hou1, Dan Benveniste1, Won Sang Lee2, Riccardo Soligo1, and Kyung Won Lee3
1Global Communication Semiconductors, LLC, 2RFHIC USA, 3RFHIC Corporation

4:40 PM  12.3 Optically-Defined 150-nm, 28-V GaN HEMT Process for Ka-Band
Kyle M. Bothe, Bruce Schmukler, Satyaki Ganguly, Terry Alcorn, Jennifer Gao, Chris Hardiman, Evan Jones, Dan Namishia, Fabian Radulescu, Jeffrey Barner, Jeremy Fisher, Don A. Gajewski, Scott T. Sheppard and Jim W. Milligan
Wolfspeed, A Cree Company

5:00 PM  12.4 3D Nanoprinting of Grayscale Features in GaN Devices to Reduce Peak Electric Fields
Andrew D. Koehler1, Geoffrey M. Foster2, James C. Gallagher2, Joseph G. Tischler1, Travis J. Anderson1, Karl D. Hobart1, Fritz J. Kub1
1U.S. Naval Research Laboratory
2ASEE Postdoctoral Fellow Residing at NRL

5:20 PM  12.5 Activation of Ion Implanted Si in Semi-Insulating C-Doped GaN by High Pressure Annealing for Photoconductive Semiconductor Switch (PCSS) Applications
James C. Gallagher1, Travis J. Anderson2, Andrew D. Koehler2, Geoffrey M. Foster1, Alan G. Jacobs1, Boris N. Feigelson2, Michael M. Mastro2, Jennifer K. Hite2, Karl D. Hobart2
1ASEE Postdoctoral Fellow Residing at NRL
2U.S. Naval Research Laboratory
6:00 PM  RUMP SESSIONS RECEPTION
6:30 PM  RUMP SESSIONS
Chair: Jansen Uyeda, Northrop Grumman

The long honored tradition of CS MANTECH’s rump session is back for more lively and “friendly” discussions among your peers in an informal and open setting. This is a perfect venue to give your take on the industry and CS technologies, as well as hear your colleagues call it as they see it. Please join us to weigh-in on four topics centered on the future of CS technologies and the upcoming 5G roll-out. Who knows… you may find a new best friend or may flip 180 on your views. Reception to precede the discussions to help lighten the mood and make the discussion more entertaining!

Moderator: Martin Kuball, University of Bristol
Location: Nicollet D1

Power electronics is getting more momentum and increasingly more multi-faceted. Si has provided significant benefits in the past, though in some technology areas it is starting to get superseded (or not ?) by SiC and GaN. As SiC and GaN battle for domination, Ga2O3 is emerging as a further alternative… so who will win? Will there be winners or losers? Are there more alternatives? Please join us for what will be an epic match, which team will you be on and who has the force to sway things… Let the games begin!

Rump Session B: “Who needs mmWave devices for 5G?”
Moderators: Earl Lum, EJL Wireless Research
Gerhard Schoenthal, Virginia Diodes, Inc.
Location: Nicollet D2

Is 5G really here and who needs it? Major U.S. mobile providers such as Verizon, AT&T, and Sprint have posted information on their 5G offerings for the first half of 2019, with T-Mobile offering their 5G network in 2020 (source: CNBC). The 2020 Summer Olympic Games in Tokyo, Japan will see full implementation of 5G. However, will the full vision of 5G be realized? Are the right technologies involved and is CS technologies in the mix? Will high-frequency devices reaching to the THz regime be needed? If so, it’s prime time for InP-based CS technologies… are manufacturers ready for this? Let’s have a fun discussion on the ground breaking possibilities that 5G will bring to our everyday life, what CS technologies are needed, and is the CS industry ready to produce these at high yield and low cost.
Rump Session C: “Future of Automotive - What is Required for Successful CS Technology Integration?”
Moderator: Yohei Otoki, SCIOCS
Location: Nicollet D3

The automotive industry is advancing and transforming at lightning speed… from new safety features to autonomous driving vehicles, all enabled with CS technologies. With this rapid development of new capabilities, what is required to ensure the reliability of CS technologies in automotive systems… and what is on the horizon? If you are a car enthusiast… this is the session for you.

8:00 PM SEMI STANDARDS MEETING
Location: St. Croix (2nd floor)
Thursday, May 2\textsuperscript{nd}

SESSION 13: OPTOELECTRONICS PLENARY

Location: Nicollet B-C
Chairs: Stephen Myers, Lumentum
       Travis Abshire, nLight

8:00 AM Invited Presentation
13.1 VCSELs at a Glance
Dr. Vincent D. Mattera, Jr
II-VI

9:00 AM Invited Presentation
13.2 Volume Manufacturing of Highly Integrated System-On-Chip (SOC) InP-Based Photonic Integrated Circuits
Fred A. Kish, Steve Maranowski, Peter Debackere, Adam James, Andrew Dentai, Paul Liu, Payam Abolghasem, Nikhil Modi, Bala Vaddepaty, Peter Evans, Vikrant Lal, Gloria E. Hoefler, Jianping Zhang, S. Stockman, and Mehrdad Ziari
Infinera Corporation

9:30 AM Invited Presentation
13.3 MicroLED Displays: Hype and Reality, Hopes and Challenges
Eric Virey, Zine Bouhamri, Pars Mukish
Yole Développement

10:00 AM BREAK
Thursday, May 2nd

SESSION 14: VCSEL
Location: Nicollet B-C
Chairs: Heribert Zull, OSRAM Opto Semiconductors
GmbH
Chris Stender, MicroLink Devices, Inc.

10:30 AM 14.1 3D Sensing/Imaging – The Next Killer
Application for VCSELS? Yes If…
Pierrick Boulay, Pars Mukish
Yole Développement

10:50 AM Invited Presentation
14.2 Future Present Foundry Model for
III-V Manufacturing
Al Yuen
Lumentum

11:20 AM Invited Presentation
14.3 Volume Manufacture of 150 mm
VCSEL Epi-wafers
Ben Stevens, Adam Jandl, Aidan Daly,
Andrew Clark, Hugues Marchand, Andrew
Joel and Rodney Pelzel
IQE PLC

11:50 AM Invited Presentation
14.4 Crystal Growth and Wafer Processing
of 6” GaAs Substrates for Lasers
Tomonori Morishita
Sumiden Semiconductor Materials Co., Ltd.
Thursday, May 2nd

SESSION 15: TEST & CHARACTERIZATION OF WIDE BANDGAP HETEROSTRUCTURES

Location: Nicollet A
Chairs: David Via, Air Force Research Laboratory  
David Meyer, Naval Research Laboratory

10:30 AM  
Student Presentation
15.1 Misinterpretation of Drain Transient Spectroscopy in GaN HEMTs: Explanation using a floating buffer model  
Manikant Singh¹, M. J. Uren¹, S. Karboyan¹,  
H. Chandrasekar¹, T. Martin², and M. Kuball¹  
¹CDTR, University of Bristol  
²IQE Europe

10:50 AM 15.2 WITHDRAWN

10:50 AM  
Student Presentation
15.3 Interfacial fracture toughness of GaN film on diamond substrate for application in ultra-high power RF devices  
Dong Liu, Stephen Fabes, Daniel Francis and Martin Kuball  
CDTR, University of Bristol

11:10 AM  
Student Presentation
15.4 Electrical and Thermal Characterisation of β-\((\text{Al}_x\text{Ga}_{1-x})_2\text{O}_3\)/Ga_2O_3 HEMTs  
Taylor Moule¹, Manikant Singh¹, Serge Karboyan¹, Elisha Mercado¹, Stefano Dalcanale¹, Michael J Uren¹, Yuewei Zhang²,  
Zhanbo Xia², Siddharth Rajan², Martin Kuball¹  
¹CDTR, University of Bristol  
²The Ohio State University

11:30 AM 15.5 New Generation of Corona-charge Noncontact C-V (CnCV) Metrology for Characterization of Wide Bandgap Interfaces and Deep Interface Traps  
M. Wilson, A. Savitchouk, C. Almeida, B. Schrayer, J. D’Amico and J. Lagowski  
Semilab SDI

12:20 PM  
CS MANTECH LUNCHEON
**Thursday, May 2nd**

**SESSION 16: PROCESS AND YIELD**

**Location:** Nicollet B-C  
**Chairs:** Guoliang Zhou, Skyworks Solutions  
Kevin Stevens, IQE

**1:30 PM**  
**16.1 Yield Improvements in a High-Mix Fabrication Environment**  
Rathnait D. Long1, Sarah R. El-Helw1,2, Ian Dalton1, Maik Katko1, Kezia Cheng1, Marco Bonilla1, William Allen1 & Craig Pastrone1  
1MACOM Technology Solutions  
2Virginia Polytechnic Institute & State University

**1:50 PM**  
**Student Presentation**  
**16.2 Effects of Electrochemical Etching on InP HEMT Fabrication**  
T. Saranovac, D. C. Ruiz, D. Han, A. Hambitzer, A. M. Arabhavi, O. Ostinelli, and C. R. Bolognesi  
Millimeter-Wave Electronics Group (MWE)  
ETH-Zürich

**2:10 PM**  
**16.3 Lift-off Challenges in using CAMP Negative Photoresist Patterning in III-V IC Fabrication**  
Daniel Berkoh and Shiban Tiku  
Skyworks Solutions

**2:30 PM**  
**16.4 Gross Die Per Wafer and Yield Optimization for GaAs ICs with Sub-Micron Features**  
Robbie Best and Shiban Tiku  
Skyworks Solutions

**2:50 PM**  
**16.5 Development of stepper solutions for new IoT device challenges**  
Bunsuke Takeshita1, Douglas Shelton2, Neel Chopra2, Hiroyuki Miyazaki3, and Ken-Ichiro Mori1  
1Canon Inc., 2Canon U.S.A.

**3:10 PM**  
**16.6 Applications of Natural Exponential Functions in Semiconductor Processes**  
Xiaokang Huang, Linlin Chen, Arif Choudhury, Duofeng Yue, Qidu Jiang, Mengdi Mueller, John Griffin, Van Tran, Amit Kelkar  
Qorvo
Thursday, May 2nd

SESSION 17: MATERIALS AND GROWTH FUNDAMENTALS

Location: Nicolle A
Chairs: Rüdiger Schreiner, Consultant
Wei Zhang, AXT

1:30 PM Invited Presentation
17.1 P-type semiconductors in gallium oxide electronics
Kentaro Kaneko1, Shu Takemoto1, Shin-ichi Kan1, Takashi Shinohe2, Shizuo Fujita1
1Kyoto University; 2FLOSFIA Inc.

2:00 PM Invited Presentation
17.2 Development of Large Diameter Semi-Insulating Gallium Oxide (Ga2O3) Substrates
J.D. Blevins1, K. Stevens2, G. Foundos2, A. Lindsey2, L. Sande3
1Air Force Research Laboratory (AFRL); 2Northrop-Grumman SYNOPTICS

2:20 PM Invited Presentation
17.3 Machine Learning for SiC top-seeded solution growth - Prediction, Optimization and Visualization
Toru Ujihara1,2,3, Yosuke Tsunooka1,2, Goki Hatasa1, Can Zhu1, Kentaro Kutsukake2, Taka Narumi1, Shunta Harada1, Miho Tagawa1
1Nagoya University; 2National Institute of Advanced Industrial Science and Technology; 3Center for Advanced Intelligence Project, RIKEN

2:50 PM Student Presentation
17.4 Analysis of High Mg-Incorporation into GaN via PAMBE Modulation Doping and Molecular Dynamics Simulations
Fawad Hassan Ismail, Matthew Landi, Frank Putnam Kelly, Kyekyoon (Kevin) Kim
University of Illinois at Urbana-Champaign

3:10 PM Student Presentation
17.5 Understanding GaN Homoepitaxial Growth and Substrate-Dependent Effects for Vertical Power Devices
Jennifer K. Hite1, Travis J. Anderson1, James C. Gallagher2, Michael A. Mastro1, Karl D. Hobart1, Francis J. Kub1, and Charles R. Eddy, Jr.1
1U.S. Naval Research Laboratory; 2ASEE Postdoctoral Fellow Residing at NRL
Thursday, May 2nd

SESSION 18: POSTER

Chairs: Barry Wu, Keysight Technologies
Shyh-Chiang Shen, Georgia Tech University
Shiban Tiku, Skyworks Solutions
Andrew Green, Air Force Research Laboratory

3:40 PM - 4:30 PM

18.1 RF GaN Market and Technology Trends
Ezgi Dogmus, Antoine Bonnabel and Hong Lin
Yole Développement

18.2 Addressing Cycle Time to Accelerate Yield Improvement and Improve Output
Michael Mandracchia
The MAX Group

18.3 Templated Liquid Phase Growth Combined with MOCVD for Growth of Crystalline III-V's Directly on Oxide and Nitride Surfaces
Debarghya Sarkar, Mitchell Dreiske, P. Daniel Dapkus, Rehan Kapadia
University of South California

Student Presentation

18.4 GaN High-Performance Low-Leakage p-Islet MPS Diodes Enabled by PAMBE-Based Selective Area Growth
Palash Sarker, Frank Putnam Kelly, Riley Elis Vesto, Fawad Hassan Ihsanl, Kyekyoong (Kevin) Kim
University of Illinois at Urbana-Champaign

18.5 β-Ga2O3 and related alloys grown by MOCVD on a Multi-wafer production system
Nazar Orishchin, Fikadu Alema and Andrei Osinsky
Agnitron Technology, Inc.

18.6 WITHDRAWN

18.7 200 V – 20 A AlGaN/GaN MIS-HEMTs on Silicon Substrate with 60 mm Gate Width
Chia-Jui Yu¹, Tz-Chau Lin¹, Chien-Ju Chen¹, Jyun-Hao Liao¹, Meng-Chyi Wu¹, Wen-Ching Hsu², Chih-Yuan Chuang², and Jia-Zhe Liu²
¹National Tsing Hua University,
²Global Wafers Co., Ltd.
Thursday, May 2nd

18.8 A High Uniformity, High Yield 0.15 µm pHEMT Technology Manufactured by KrF 248 nm Stepper
Chao-Min Chang1, Pei-Chin Chiu1, Jeng-Han Tsai2, Hui-Hsin Sun2, Yun-Yue Hsieh2, Zhi-Jie Zeng1, Kun-Lin Lu1, Chih-Peng Lin1, Bo-Chin Wang1, Sheng-Chun Wang1, Chin-Fu Lin1
1Wavetek Microelectronic Corp.
2National Taiwan Normal University

Student Presentation
18.9 High Thermally Stable AlGaN/GaN High Electron Mobility Transistors (HEMTs) on Bulk Semi-Insulating GaN Substrates
Hao-Yu Wang1, Hsien-Chin Chiu1, Chong-Rong Huang1, Hao-Chung Kuo2, Sung-Wen Huang Chen2, Xinke Liu3
1Chang Gung University
2National Chiao Tung University
3Shenzhen University

Student Presentation
18.10 Reconfigurable 43 Gb/s Optical Link Test Based Upon On-Wafer Probes of GaAs Photodetectors and VCSELs up to 85 °C
Yu-Ting Peng, Junyi Qiu, Dufei Wu, Milton Feng
University of Illinois at Urbana-Champaign

Student Presentation
18.11 Development of GaN Vertical High-Power Devices Enabled by Plasma-Assisted Molecular Beam Epitaxy
Frank Putnam Kelly, Riley Elis Vesto, Palash Sarker, Fawad Hassan Ismail, Kyekyoon (Kevin) Kim
University of Illinois at Urbana-Champaign

Student Presentation
18.12 Comparative investigation of lattice-matched ternary and quaternary barriers for GaN-based HEMTs
S.Riedmüller1,2, J. Grünepütt1, M. Madel1, and H. Blanck1
1United Monolithic Semiconductors GmbH
2University of Ulm
Thursday, May 2nd

Student Presentation
18.13 A Novel AlGaN/GaN MIS-HEMT with Enhanced Breakdown Voltage and Reduced Interface Trap Density
Chao Yang, Xiaorong Luo, T. Sun, A. Zhang, D. Ouyang, S. Deng, J. Wei, and Bo Zhang
*University of Electronic Science and Technology of China*

18.14 Buffer development for GaN power electronic applications using extrinsic carbon doping for a super-lattice structure
D. Fable, M. Marx, H. Behmenburg, M. Kortemeyer, M. Heuken
*AIXTRON SE*

18.15 Dynamic Hydride Vapor Phase Epitaxy (D-HVPE) as a route to inexpensive, high-performance III-V materials and devices
John Simon, Kevin L. Schulte, Wondwosen Metaferia, Alessandro Cavalli, and Aaron J. Ptak
*National Renewable Energy Laboratory*

18.16 Innovative relaxed InGaN engineered substrates for red-green-blue µLEDs applications
Eric Guiot¹, David Sotta¹, Olivier Ledoux¹, Amélie Dussaigne², Sébastien Chenot¹, Benjamin Damilano³
¹SOITEC S.A., ²Univ. Grenoble Alpes ³Université Côte d’Azur, CNRS

4:30 PM CONFERENCE CLOSING

Chairs: Eric Stewart, *Northrop Grumman*
Greg Mills, *AXR*

Make sure to stay for the fun at the conference closing this year! Local comedian John DeBoer will be giving a short stand-up routine about Minnesota, cold weather, and engineers. Take a moment to enjoy a few laughs at the end of the week.
2018 BEST PAPERS AWARDS

On Tuesday morning, CS MANTECH will formally recognize the authors of the best paper and best student paper from the 2018 conference. Both awards are based on conference attendee on-line feedback. The Best Paper Award is named in honor of Dr. He Bong Kim, the founder of the International Conference on Compound Semiconductor Manufacturing Technology.

2018 He Bong Kim Best Paper:
**Looking for reliability and high performance in RF and power conversion applications? Use GaN.**
Umesh Mishra  
*University of California Santa Barbara & Transphorm Inc.*

2018 He Bong Kim Best Paper Honorable Mention:
**Automotive Industry Trends and Their Impact on the Future Vehicle**
Kamal Khouri  
*NXP Semiconductors*

2018 Best Student Paper:
**Controlling Impurity-Induced Disordering Via Mask Strain for High-Performance Vertical-Cavity Surface-Emitting Lasers**
Patrick Su, Thomas O’Brien, Jr., Fu-Chen Hsiao, and John M. Dallesasse  
*University of Illinois at Urbana-Champaign*

Congratulations to these award winning teams for their excellent presentation and technical contribution to our field!
TRANSPORTATION INFORMATION

Transportation Centers:
MSP International Airport (MSP): 12 miles from the hotel
Amtrak Station: 8 miles from the hotel

Public Transit Centers:
Light Rail station: 8 blocks from the hotel and takes you toward downtown, Mall of America, the airport, and St. Paul
Greyhound Bus Station: located 7 blocks from the hotel

Taxi:
Taxi transportation between the Hyatt Regency Minneapolis and the airport is approximately $45 - $50 for one passenger.

Ride-share:
Ride-share services from Uber & Lyft between the Hyatt Regency Minneapolis and the airport are approximately $23 - $42 for one passenger

Local Transit:
Single ride is $2.50. Day pass is $5. From the airport, take the blue line towards Target Field to Nicollet Mall stop. Then walk 8 blocks south on Nicollet Mall to the Hyatt Regency.

Airport SuperShuttle:
Transfer from the airport to the hotel is $14.40 per person with discount code BN5F2. Reservations are recommended from the airport to the hotel, and advance pickup arrangements must be secured to travel from the hotel to the airport. https://group.supershuttle.com/group-page/2019-cs-mantech-conference/

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The Loring Parking Ramp is privately owned and is managed by Allied Parking Inc.
Overnight Self-Parking: $24
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