



GaAs MANTECH

DIGEST OF PAPERS

2001 International Conference
on
Compound Semiconductor
MANufacturing TECHnology

www.gaasmantech.org

Mirage Hotel
Las Vegas, Nevada, U.S.A.
May 21-24, 2001

2001 GaAs MANTECH Conference

Digest of Papers

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**2001
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MANufacturing TECHnology**

**Las Vegas, Nevada, U.S.A.
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CONFERENCE AT A GLANCE

SUNDAY, MAY 20

5 :00 pm – 9:00 pm

REGISTRATION

Registration Desk 4, Rotunda

MONDAY, May 21

7:00 am – 8:30 am

7:00 am – 8:00 am

8:00 am – 5:00 pm

11:30 am – 12:30 pm

4:00 pm – 8:00 pm

6:00 pm – 9:00 pm

Registration

Continental Breakfast

GaAs MANUFACTURING WORKSHOP

Workshop Luncheon

Registration

EXHIBITS RECEPTION

Registration Desk 4, Rotunda

Events Center C1

Events Center C1

Bermuda A/B

Registration Desk 4, Rotunda

Events Center C2 & C3

TUESDAY, May 22

7:00 am – 11:00 am

7:00 am – 8:00 am

7:00 am – 3:30 pm

8:00 am – 10:20 am

10:20 am – 10:40 am

10:40 am – 12:10 pm

12:10 pm – 1:40 pm

1:40 pm – 3:00 pm

3:00 pm – 3:30 pm

3:00 pm – 6:00 pm

3:30 pm – 5:30 pm

7:00 pm – 10:30 pm

Registration

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Exhibits Open

PLENARY, SESSION 1

Break

SESSION 2: HBT

Exhibits Luncheon

SESSION 3: High Volume Production

Break

Registration

SESSION 4: Panel

INTERNATIONAL RECEPTION,

Registration Desk 4, Rotunda

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Events Center C2 & C3

Events Center C1

Events Center C2 & C3

Events Center C1

Events Center C2 & C3

Events Center C1

Events Center C2 & C3

Registration Desk 4, Rotunda

Events Center C1

WB Stage 16, Venetian Hotel

WEDNESDAY, May 23

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7:00 am – 8:00 am

8:00 am – 9:20 am

9:20 am – 9:40 am

9:40 am – 12:00 pm

12:00 am – 1:00 pm

1:00 pm – 5:00 pm

1:20 pm – 2:40 pm

3:00 pm – 5:00 pm

5:30 p.m. – 7:00 pm

Registration

Continental Breakfast

SESSION 5: Materials

Break

SESSION 6: Advanced Technologies

Awards Luncheon

Registration

SESSION 7: Lithography & Gate formation.

SESSION 8: Interactive Forum

and Ugly Picture Contest

SEMI Standards

Registration Desk 4, Rotunda

Events Center C1 Foyer

Events Center C1

Events Center C1 Foyer

Events Center C1

Events Center C2

Registration Desk 4, Rotunda

Events Center C1

Events Center C3

Andros A

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7:00 am – 8:00 am

8:00 am – 9:20 am

8:00 am – 9:20 am

9:20 am – 9:40 am

9:50 am – 11:30 am

9:40 am – 11:30 am

11:30 am – 1:30 pm

1:30 pm – 2:40 pm

2:40 pm – 3:00 pm

3:00 pm – 4:30 pm

4:30 pm – 5:30 pm

5:30 pm

Registration

Continental Breakfast

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SESSION 9B: Indium Phosphide

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SESSION 10A: Backside Processing

SESSION 10B: Reliability

Lunch

SESSION 11: MHEMT

Break

SESSION 12: Factory Automation

Ugly Picture Contest Finals

Close of Conference

Registration Desk 4, Rotunda

Events Center C1 Foyer

Events Center C1

Events Center C2

Events Center C1 Foyer

Events Center C1

Events Center C2

Attendees' Choice

Events Center C1

Events Center C1 Foyer

Events Center C1

Grand Ballroom E

MESSAGE FROM THE CHAIR

On behalf of the 2001 GaAs MANTECH Executive Committee, I am pleased to welcome you to the 16th annual MANTECH conference being held May 21st through May 24th at the Mirage Hotel in Las Vegas, Nevada.

When the conference committee met last year to plan for this conference, we were in the midst of one of the greatest growth periods our industry has ever experienced. The committee was excited to choose topics relating to how our manufacturing organizations were adjusting to cope with the unprecedented demand and elected as our theme "Compound Semiconductor Manufacturing: Meeting the Challenges of Explosive Growth." However, as we go to press with the conference digest some nine months later, the business cycle has swung in the other direction. The growth estimates for the industries that consume our products are being revised downward on a monthly basis. Many of our companies are reducing earnings estimates for the year. On the other hand, just as quickly as the down cycle began, the economic analysts are predicting we will again change direction towards the up cycle before the technical program committee next meets to choose the theme for the 2002 conference! Now is the time to invest our resources in preparing for the return to the explosive growth scenarios we expect in our traditional markets and to investigate newer technological opportunities that will shape our industry in the future.

To that end, the program committee has reviewed the focus of the technical program for the conference and has determined that focusing on just GaAs manufacturing technology no longer reflected the full scope of the majority of the companies we represent. Many of the factories in our industry are also developing products based on other compound semiconductor technologies as well, such as InP and GaN. With the tremendous growth in optical networking, there are exciting opportunities to exploit the high-speed nature of these compound semiconductors and their ability to switch optical signals with electrical stimulus. Reflecting the migration of our business to the broader technology base, the Executive Committee has approved a change in the conference title to "GaAs MANTECH, International Conference on Compound Semiconductor MANufacturing TECHnology", as shown on the cover. The trademarked conference logo will remain "GaAs MANTECH" as an honored part of our heritage. We hope you find the expanded coverage useful in helping you to do your job.

The Technical Program Committee has excelled in bringing together special sessions that focus on the expanded role of the conference this year. Specifically, there are sessions devoted to both Gallium Nitride and Indium Phosphide. A particularly timely topic is this year's panel session discussing outsourcing of production for compound semiconductors. While the silicon world has a manufacturing segment where outsourcing is an established method of doing business, the compound semiconductor industry has, to date, relied on a more traditional approach of foundry arrangements. Please join us to hear what this panel of industry experts has to say about the ability of the compound semiconductor industry to participate in such a business model. You are encouraged to bring your views and ideas to this discussion, to help shape what may well be an inflection point in our industry. In order to fulfill the variety of requests for varying topics at the MANTECH Workshop, we have expanded the program this year to a fifth session with topics ranging from fab design and automation to a tutorial on metamorphic HEMT technology. The technical program continues to be a forum where new ideas to the traditional issues we face in our industry are discussed in detail, such as through wafer via process optimization, reliability and lithography challenges.

I cordially invite you to our awards luncheon to be held on Wednesday May 23, to help congratulate the He Bong Kim Best Paper Award winners for the year 2000: W.J. Roesch, S. Peterson, A. Poe, S. Brockett, S. Mahon, and J. Bruckner, of TriQuint Semiconductor, for their paper titled "Assessing Circuit Hermeticity by Electrolysis." The Best Student Paper Award will be presented to C.A. Steer, J.L. Luo, and D.G. Ivey, of the University of Alberta for their paper titled "Corrosion Behavior and Surface Studies of GaAs in Acidic Solution."

At the time of digest publication, there are over 85 companies committed to exhibiting at the conference. The GaAs MANTECH conference continues to provide the largest exhibition forum dedicated to providing interaction with the compound semiconductor manufacturing community. Please join me Monday evening at the exhibits reception where you can stroll among the many booths and check out the latest information from the many companies while enjoying a delicious buffet dinner.

Best Regards,
Bruce Bernhardt, Conference Chairman
2001 GaAs MANTECH, International Conference on Compound Semiconductor Manufacturing Technology.

GaAs Mantech Conference, May 21-24, 2001, Las Vegas, Nevada

CONFERENCE SPONSORS

The 2001 Compound Semiconductor MANTECH Conference Committee gratefully acknowledges the tremendous support we receive from our sponsors. Each year their contributions enable us to bring the best possible technical program to our attendees and continuously make the conference better and more enjoyable for everyone.

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Wednesday Refreshment

Thursday Refreshment

Conference Funding

Conference Funding

Conference Funding

Conference Ballroom

Conference Funding

Audio/Video

Conference Funding

Ugly Picture Contest

Conference Funding

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Workshop Facility

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CONFERENCE EXHIBITORS

The 2001 Compound Semiconductor MANTECH Conference recognizes the critical importance of advanced materials and equipment in the successful growth of the industry. The conference exhibits provide a venue for communication and conversation between vendors and users to support the advances demanded by a fast-moving industry.

Accent Optical Technologies
Aixtron Incorporated
Akzo Nobel
American Xtal Technology, Inc.
Applied EPI, Incorporated
APT
ASML Lithography, Incorporated
ATMI
August Technology Corp.
B.L.E. Technology, Inc.
Bede Scientific Inc
BPS Technology Inc.
Charles Evans & Associates
Clariant Corp., AZ Electronic Materials
Compound Semiconductor Magazine
Component Sources International Inc.
Denton Vacuum LLC
Dow Chemical Advanced Electronic Materials
Eco-Snow Systems, Incorporated
Emcore
Epitaxial Products Incorporated
Epitaxial Technologies, LLC
Epiworks, Incorporated
EV Group, Incorporated
Freiberger Compound Materials
General Chemical Corporation
Global Communication Semiconductors
Global Communication Technology, Corp.
Grinding Machines Nuernberg, Inc.
Hitachi Cable America, Inc.
Hologenix, Inc.
III-Vs Review
Implant Sciences Corporation
Insaco, Incorporated
Intelligent Epitaxy Technology, Inc
Jobin Yvon Incorporated
Karl Suss
Kopin Corporation
Kyocera Industrial Ceramics Corp.
Lake Shore Cryotronics
Leighton Electronics
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Logitech Product Group
Mattson Thermal Products GmbH
M/A Com/ Tyco Electronics
MAX I.E. LLC
MBE Technology
Modular Process Technology
OSEMI INC
Oxford Instruments Inc.
Philips Analytical
Picogiga
Procomp Informatics Ltd.
Reedholm
Riber
RJM Semiconductor
Rudolph Technologies, Incorporated
S.T. Systems U.S.A. , Incorporated
Saes Pure Gas
Semitool
Silicon Tech Limited (JM Tech Int.)
Silvaco Data Systems
Solid State Equipment Corporation
Solitec Wafer Processing
Solkatronic Chemicals
Spectrolab
Sumitomo Electric (Semia)
System Control Technology (SCT)
Tegal
Temescal
The Gem City Engineering Co.
Thermal VG Semicon
Trikon Technologies LTD.
Trion Technology
TSK America
Ultratech Stepper, Inc.
Unaxis
Vacuum Engineering and Materials
Veeco Instruments
Visual Photonics Epitaxy Co., Ltd.
Williams Advanced Materials Inc.
Win Semiconductors Corp.
Yield Engineering Systems

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Lucky Lim Leong, *Certified Public Accountant*

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Lucky Leong, LLC

HE BONG KIM AWARDS

Established in 1986 to recognize outstanding technical papers presented during the Conference, the He Bong Kim Award is named for the founding Conference Chairman whose vision and desire for excellence is continued today.

- 2000 AWARD WINNERS** **"Assessing Circuit Hermeticity by Electrolysis,"** W.J. Roesch, S. Peterson, A. Poe, S. Brockett, S. Mahon, and J. Bruckner, *TriQuint Semiconductor*
- 2000 Best Student Paper** **"Corrosion Behavior and Surface Studies of GaAs in Acidic Solution,"** C.A. Steer, J.L. Luo, and D.G. Ivey, *University of Alberta*
- 1999 AWARD WINNERS** **"Progress in SiC Materials and Resulting Devices,"** J. Palmour, C. Carter, Jr., R. Singh, S. Allen, R. Sadler, W. Pribble, and S. Sheppard, *Cree Research*
- 1999 Honorable Mention** **"GaAs Heterojunction Bipolar Transistor Emitter Design,"** R. E. Wesler, N. Pan, C. R. Lutz, D. P. Vu, *Kopin* and P. J. Zampardi, R. L. Pierson, B. T. McDermott *Rockwell*
- 1999 Gregory E. Stillman Student Paper Award** **"Effects of Ballast Resistors on Power and ESD Performance in AlGaAs/GaAs Heterojunction Bipolar Transistors,"** C.Y. Chu, J. J. Sheu, G.P. Li, *University of California, Irvine*, and W.J. Ho, H.Y. Hsu, T-M Kao, C. Hua, *Network Devices Incorporated*
- 1998 AWARD WINNERS** **"GaAs Manufacturing: Myth and Reality,"** L. Tomasetta, *Vitesse Semiconductor Corporation*
- "10 Years Production Using the GaAs MESFET DIOM Process,"** Otto Berger, *Siemens Semiconductor Group*
- 1998 Honorable Mention** **"E-Beam Evaporation: Photo Resist Critical Dimensions & Substrate Adhesion Dependence of Throw Distance, Deposition Rate, Radiation, and Film Stress,"** D. Kuhn, K. Pruett, A. Dashiwagi, J. Peterson, K. Yamamoto, L. Studebaker, S. Lafrancois, and N. Caldwell, *Hewlett-Packard Company*
- 1998 Best Student Paper** **"Recoverable Drift in Output Power of PHEMTs Under RF Overdrive,"** R. Leoni III, J. Bao, J. Bu, and J. Hwang, *Lehigh University*

HE BONG KIM AWARDS

1997 AWARD WINNERS:	T. Cordner, <i>TriQuint Semiconductor, Inc.</i>
	T. Henderson, W.L. Chen, and M. Sanna, <i>TriQuint Semiconductor, Inc</i>
1997 Honorable Mentions:	C. Goldsmith, S. Eshelman, J. Randall, Z. Yao, T. Moise, D. Denniston, S. Chen and M. Avery, <i>Raytheon TI Systems</i>
	T. Jakobus, W. Bronner, A. Gaymann, F. Grotjahn, J. Hornung, V. Hurm, K. Kohler, M. Ludwig and Z. Wang, <i>Fraunhofer Intitut für Angewandte Festkörperphysik</i>
1996 AWARD WINNER:	M. R. Wilson, R. Balda, C. Della, J. Gilbert, E. Huang, and L. S. Klingbeil, <i>Motorola</i>
Honorable Mention	G. DeSalvo, J. Ebel, C. Bozada, J. Barrette, C. Cerny, R. Dettmer, J. Gillespie, C. Havasy, T. Jenkins, K. Nakano, C. Pettiford, T. Quach, J. Sewell, and D. Via, <i>Wright Laboratory</i>
1995 AWARD WINNERS:	J. Brown, A. Schmitz, M. Thompson, C. Hooper, <i>Hughes</i> and J. Josefowicz, <i>University of Pennsylvania</i>
Honorable Mention:	B. A. Rioux, M. C. Young, and L. Bourbonnais, <i>Northern Telecom</i>
1994 AWARD WINNERS:	E. Finchem, W. Mickanin, and C. Rosemeyer, <i>TriQuint Semiconductor, Inc</i>
Honorable Mentions:	Terry Pope, <i>Motorola</i>
	H. Liu, C. Su, N. Farrar, and B. Gleason, <i>Hewlett-Packard</i>
1993 AWARD WINNERS:	P. D. Cooper, J.D. Kennedy, R. J. Street, <i>Martin Marietta</i>
	W.P. Kornrumpf, and W. M. Marcinkiewicz, <i>GE Corporate R&D Center</i>
	Dr. J.J. Wooldridge, <i>Hughes Aircraft</i>
1992 AWARD WINNER:	W.J. Roesch, <i>TriQuint Semiconductor, Inc.</i>
Honorable Mentions:	M. Rigik, <i>TriQuint Semiconductor, Inc.</i>
	J. Oakes and M. Durschlag, <i>Raytheon</i>
	D. Carlson, C. Maiorino and J. Vaughan, <i>M/A-COM</i>
1991 AWARD WINNERS:	D. H. Rosenblatt, B. D. Cantos, T. T. Kennel, C. H. Olson, and R. D. Remba, <i>Watkins-Johnson Company</i>
Honorable Mentions:	B. Studtmann, A. Geissberger, R. Sadler, and M. Balzan, <i>ITT GaAs Technology Center</i>
1990 AWARD WINNER:	W. J. Roesch and R. J. Allen, <i>TriQuint Semiconductor, Inc.</i>
Honorable Mention:	R. Christ, <i>TriQuint Semiconductor, Inc.</i>
1989 AWARD WINNERS:	J. G. Roper, <i>TriQuint Semiconductor, Inc.</i> and T. Cordner, <i>Texas Instruments</i>
Honorable Mentions:	D. Monthei, <i>TriQuint Semiconductor, Inc.</i> and R. C. Vehse, <i>AT&T</i>
1988 AWARD WINNERS:	W.J. Roesch and D. Stunkard, <i>TriQuint Semiconductor, Inc</i>
Honorable Mentions:	B. Avrit, and J. G. Roper, <i>TriQuint Semiconductor, Inc.</i> and J. Mogab, <i>MSC</i>
1987 AWARD WINNERS:	D. Nelson, C. Imboden and G. Welch, <i>Gigabit Logic</i> and J. G. Roper, <i>TriQuint Semiconductor, Inc</i>

MESSAGE FROM THE TPC CHAIR

The wish “May you live in exciting times!” is an apt description of the last year in our industry. We have experienced both unparalleled growth and rapid changes in the business climate. Our conference theme, picked by the TPC in December, may now appear somewhat less explosive to our participants. Yet, for those of us who have weathered other semiconductor business cycles, the knowledge that our technology and its applications are an integral part of our societal infrastructure provides justification for future optimism.

History in the high technology world has shown us repeatedly that dips in the business cycle are the time to prepare for the next upturn: to forge ahead in technology development, to train new engineers and to sharpen our manufacturing skills and infrastructure. In response to our surveys, the TPC has worked hard to select papers that give both “nuts and bolts” information that can make an immediate positive impact on your production line as well as views of emerging technologies that will be tomorrow’s manufacturing challenges.

The strength of the MANTECH Conference lies in the interaction of the technologists from around the world who come together in an open environment to discuss manufacturing problems and their solutions. Once again this year, an increasing number of abstracts was received for review, reflecting the continued growth of our community. The 2001 conference presents the contributions of 60 papers from 71 companies, universities, and government laboratories, representing the contributions of over 300 workers. Participation from the international community is reflected in 28% of the presentations.

I invite you to attend the always popular workshop on Monday with five topics presented by industry experts. Specifically the sessions are: *“Fab Design in GaAs”*, by Oded Tal of Max International Engineering which will present an overview of the entire “fab design” process. Once you have that costly fab designed, the pressure to get it producing efficiently at high volume is intense. Curt Barratt and Mike Fresina of RF Micro Devices, will discuss *“Factory Automation”* based on their extensive experience. Of course, no amount of automation will cure design ills and solid design is based on accurate device models. *“Practical Process and Device Modeling of Compound-Semiconductor Transistors”* by Robert Anholt of Gateway Modeling, will help give an expert’s view of this critical step. Understanding the challenges of emerging technologies is critical for staying competitive. *“MHEMT Basics”* by Thomas Kazior of Raytheon RF Components will give an introduction as well as detailed insights into these devices. As device technology is scaled ever more aggressively, plasma processing becomes increasingly critical for dimensional control. Jay Sasserath of Unaxis USA will present *“Plasma Processing for MMIC Device Manufacture”* to introduce the basics as well as some of the subtle aspects of plasma processing.

The special sessions for the year 2001 conference include the plenary session and the panel session on manufacturing outsourcing. The interactive forum has proven popular as a method of promoting one-on-one exchanges between the conference participants and authors. This will be held Wednesday afternoon, along with the preliminary voting for the “Ugly Picture Contest.” In the Exhibition, suppliers are again finding the MANTECH conference to be an ideal setting to keep their customer base informed of new equipment, processes, and materials. There are over 85 exhibitors registered for our exhibition sessions on Monday evening and all day Tuesday.

I would also like to thank the 2001 conference sponsors for their support. More new sponsors have contributed this year, allowing us to enhance our services to the compound semiconductor community. As always, the MANTECH organization welcomes your input on how to improve the conference. Please provide your feedback to any of the technical program committee members or directly to me.

As TPC Chair for 2001, I would like to thank all the conference participants – their contributions and the support of their organizations makes MANTECH possible. In addition, I would like to express my heartfelt thanks to the TPC and Executive Committee for volunteering their time and support to MANTECH.

Have a great conference!

Wes Mickanin, Technical Program Chair
2001 GaAs MANTECH, International Conference on Compound Semiconductor Manufacturing Technology.

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DeLuca, P.M.	Kopin Corporation	2.4
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Doerner, R.	Ferdinand-Braun-Institut für Hochstfrequenztechnik	2.2
Doser, W.	United Monolithic Semiconductors GmbH	2.2
Dragoi, V.	Max Planck Inst. of Microstructure Physics	10A.4
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Dumka, D.C.	Univ. of Illinois	11.1
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Fay, F.	Raytheon RF Components Company	8.5
Feng, M.	University of Illinois	2.3, 6.3, 8.3, 8.4
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G		
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Z		
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Zou, Joanne	Conexant Systems	10B.3