

North America Compound Semiconductor Materials Committee Meeting Summary and Minutes

CS MANTECH 2013

Wednesday, May 15, 2013

7:00 PM to 9:00 PM (CDT), Melrose Room

Hilton New Orleans Riverside Hotel in New Orleans, Louisiana

Next Committee Meeting

The next NA Compound Semiconductor Materials meeting will be a virtual meeting via teleconference and web meeting. Meeting date, time and details when available will be announced to the committee and posted at the SEMI Standards Calendar of Events: <http://www.semi.org/en/Standards/CalendarEvents>

Table 1 Meeting Attendees

Italics indicate virtual participants

Co-Chairs: James Oliver (Northrop Grumman), Russ Kremer (Freiberger)

SEMI Staff: Michael Tran

<i>Company</i>	<i>Last</i>	<i>First</i>	<i>Company</i>	<i>Last</i>	<i>First</i>
AXT	Badawi	Hani	NIST	Davydov	Albert
Freiberger	Kremer	Russ	Northrop Grumman	King	Matt
Lehigh Electronics	Nguyen	Danh	Northrop Grumman	Oliver	Jim
<i>Lehigh Electronics</i>	<i>Blew</i>	<i>Austin</i>	NOVASIC	Kronwasser	Judy
Lehigh Electronics	Lauer	Lee	<i>SEMI N.A.</i>	<i>Tran</i>	<i>Michael</i>

Table 2 Leadership Changes

<i>Group</i>	<i>Previous Leader</i>	<i>New Leader</i>
Germanium (Ge) for Photovoltaic (PV) Applications TF	Hani Badawi (AXT)	(disbanded)

Table 3 Ballot Results

Passed ballots and line items will be submitted to the ISC Audit & Review Subcommittee for procedural review.

Failed ballots and line items were returned to the originating task forces for re-work and re-balloting.

<i>Document #</i>	<i>Document Title</i>	<i>Committee Action</i>
5544	Revision of SEMI M9.1-96E (Reapproved 0308), Standard for Round 50.8 mm Polished Monocrystalline Gallium Arsenide Wafers for Electronic Device Applications with title change to: Specification for Round 50.8 mm Polished Monocrystalline Gallium Arsenide Wafers for Electronic Device Applications	Passed as balloted. Superclean.
5545	Revision of SEMI M9.2-96E (Reapproved 0308), Standard for Round 76.2 mm Polished Monocrystalline Gallium Arsenide Wafers for Electronic Device Applications with title change to: Specification for Round 76.2 mm Polished Monocrystalline Gallium Arsenide Wafers for Electronic Device Applications	Passed as balloted. Superclean.
5546	Revision of SEMI M9.5-96E (Reapproved 0308), Standard for Round 100 mm Polished Monocrystalline Gallium Arsenide Wafers for Electronic Device Applications with title change to: Specification for Round 100 mm Polished Monocrystalline Gallium Arsenide Wafers for Electronic Device Applications	Passed as balloted. Superclean.
5547	Revision of SEMI M9.6-95E (Reapproved 0308), Standard for Round 125 mm Diameter Polished Monocrystalline Gallium Arsenide Wafers with title change to: Specification for Round 125 mm Diameter Polished Monocrystalline Gallium Arsenide Wafers	Passed as balloted. Superclean.

Table 4 Authorized Activities

There were no authorized activities.

Table 5 Authorized Ballots

<i>#</i>	<i>When</i>	<i>SC/TF/WG</i>	<i>Details</i>
4979	Cycle 6 or 7-2013	Gallium Nitride (GaN) TF	New Standard: Specification for Polished Monocrystalline Gallium Nitride Wafers

Table 6 New Action Items

<i>Item #</i>	<i>Assigned to</i>	<i>Details</i>
2013May#01	Albert Davydov	Send Judy Kronwasser the number for the melting point at atmosphere pressure for Document 4979 (Specification for Gallium Nitride).
2013May#02	Albert Davydov	Assist Judy Kronwasser with the flats orientation of Gallium Nitride and Sapphire in Document 4979.
2013May#03	Michael Tran	Work with Judy Kronwasser on DIN standards being referenced in Document 4979.

Table 7 Previous Meeting Actions Items

<i>Item #</i>	<i>Assigned to</i>	<i>Details</i>	<i>Status</i>
2012Oct#01	Michael Tran	Check with SEMI international staff to see if companies in their regions would be interested in the GaN HEMT Mobility Round Robin.	CLOSED.
2012Oct#02	Jim Oliver	Contact Hani Badawi whether to disband the Ge for PV Applications TF.	CLOSED. Hani approved to disband.
2012Oct#03	Jim Oliver, Judy Kronwasser, and Arnd Weber	Will discuss in a three-way call about the IP issues and plans going forward for M55.	CLOSED. Document will remove all potential IP issues.

Table 7 Previous Meeting Actions Items

<i>Item #</i>	<i>Assigned to</i>	<i>Details</i>	<i>Status</i>
2012Oct#04	Michael Tran	Send Russ Kremer SEMI M9.7-0708 — <i>Specification for Round 150 mm Diameter Polished Monocrystalline Gallium Arsenide Wafers (Notched)</i> for the five-year review.	CLOSED. Document to be balloted by Russ Kremer for Cycle 6 or 7-2013.
2012Oct#05	Michael Tran	Revise the Purpose and Scope of SEMI M9.1, M9.2, M9.5, M9.6 and send them to the committee leaders for review and GCS approval for Cycle 1 or 2 balloting.	CLOSED.
2011Sep #02	Paul Trio and Kevin Nguyen	Look into the mobility standard developed by the Japan CSM committee.	Still open.
2011Sep #03	Jim Oliver	Help find volunteers, possibly from Cree or II-VI, to lead the SiC Task Force.	In progress.

1 Welcome, Reminders, and Introductions

1.1 Jim Oliver and Russ Kremer, committee co-chairs, called the meeting to order at 07:00 PM CDT. The meeting reminders on antitrust issues, intellectual property issues and holding meetings with international attendance were reviewed. Attendees introduced themselves.

Attachment: 01, Required Meeting Elements

2 Review of Previous Meeting Minutes

2.1 The committee reviewed the previous meeting minutes from CS MANTECH 2012 and the Virtual Meeting during Fall 2012.

Motion: To approve the previous meeting minutes from CS MANTECH 2012 and the Virtual Meeting during Fall 2012 as written.

By / 2nd: Russ Kremer (Freiberger) / Lee Lauer (Lehightron Electronics)

Discussion: None.

Vote: Unanimous in favor. Motion passed.

Attachment: 02, NA CSM (CS MANTECH 2012) Meeting Minutes

Attachment: 03, NA CSM Virtual Meeting Minutes (Fall 2012)

3 Liaison Reports

3.1 ASTM F1.15 Subcommittee

3.1.1 F1.15 GaN Epitaxial Wafer Reference Material Task Force

3.1.1.1 Albert Davydov (NIST) reported for the F1.15 GaN Epitaxial Wafer Reference Material Task Force. The Task Force made some progress as they were able to acquire a few GaN on Sapphire 2 inch wafer samples from Ostendo (formerly TDI, Inc.); one unintentionally doped n-type, and one Si doped. The TF also received a 3 inch sample from Kyma, unintentionally doped n-type GaN on Sapphire. The TF is working with Danh Nguyen on obtaining some GaN on SiC wafers.

3.1.1.2 The TF will carry on with the following methods for non-destructive and destructive methods:

- electrical: Eddy-current; Hall; C-V, CTLM;

- optical: PL, CL, Raman;
- microstructural: TEM, XRD

3.1.1.3 For the electrical hall testing, Shannon Duff from NIST patterned the GaN samples from Otendu and Kyma with metal contacts and diced from the full wafers and the Hall results are expected in early-June, 2013.

Attachment: 04, ASTM F1.15 - GaN Update (CS MANTECH 2013)

3.1.2 *GaN HEMT Mobility Round Robin*

3.1.2.1 Danh Nguyen (Lehightron Electronics) reported for the GaN HEMT Mobility Round Robin. Danh said II-VI Incorporated donated five samples of their 3" Silicon Carbide substrates and Dr. Ming Pan from IQE-RF will help grow the GaN on the samples. The Round Robin is still waiting for donations of sample substrates from Cree and Veeco, but first they will have to work through restrictions, constraints, and non-disclosure agreements (NDAs).

3.1.2.2 The first round for the round robin will be non-contact / non-destructive measurement wafers including, GaN on SiC. The second round is to have wafers cleaving into 10 x 10 mm with ohmic for measure by Destructive Hall measurements. So far, Northrop Grumman, Texas State University, and Lehightron Electronics will be participating in the non-destructive / destructive testing and the round robin is still awaiting word from other companies.

3.1.2.3 Danh is asking for help in developing the procedures for cleaving the wafers and for making contacts. Further assistance in measurement procedures and conditions would be helpful. Also volunteers to confirm, test schedules and conditions for both non-destructive and destructive testing. Everybody is welcome to join the round robin. Please contact the round robin leader, Danh Nguyen at danh@lehightron.com or 610-377-5990.

Attachment: 05, GaN HEMT Mobility Round Robin Update (CS MANTECH 2013)

3.2 *Europe Compound Semiconductor Materials Committee*

3.2.1 Michael Tran (SEMI N.A.) gave the Europe Compound Semiconductor Materials Report. The key items were as follows:

- The committee chair is Arnd Weber (SiCrystal)
- Meetings
 - Last meeting was in off site in Nürnberg, Germany, 17th April, 2013
 - Next meeting to be October 2013, in conjunction with SEMICON Europa
- Global SiC TF
 - The TF did not receive the LoA for Document 3784A, *New Standard: Specification for 100 mm Round Polished Monocrystalline 4H and 6H Silicon Carbide Wafers*. The document will have to be technically rework without the IP material.
- GaSb Wafer Specification Global TF
 - The TF was disbanded due to no further activities.
- Carbon in GaAs TF
 - The TF was disbanded due to no further activities.
- EPD Measurement in GaAs TF
 - The TF was disbanded due to no further activities.
- Contactless Capacitive Resistivity Measurement of SI-Semiconductors TF
 - The TF is working on a draft of a document for Capacitive Measurements

- SEMI EU Contact, Yann Guillou (yguillou@semi.org)

Attachment: 06, EU CSM Report (CS MANTECH 2013)

3.3 *Japan Compound Semiconductor Materials Committee*

3.3.1 There was no report received.

3.4 *SEMI Staff Report*

3.4.1 Michael Tran (SEMI N.A.) gave the SEMI Staff Report. The key items were as follows:

- Some Upcoming SEMI Major Events
 - SEMICON West 2013
 - July 9-11, 2013 in San Francisco, CA, USA
 - SEMICON Taiwan 2013
 - September 4-6, 2013 in Taipei
 - SEMICON Europa 2013
 - October 8-10, 2013 in Dresden, Germany
- Upcoming North America Standards Meetings
 - NA Compound Semiconductor Materials Committee in conjunction with CS MANTECH 2013
 - May 15, 2013 in New Orleans, Louisiana
 - NA Standards Meetings at SEMICON West 2013
 - July 8-11, 2013 in San Francisco, California
- Cycle 4 and 5-2013 Critical Dates for SEMI Standards Ballots
 - Cycle 4, 2013
 - Ballot Submission Date: May 20, 2013
 - Voting Period Starts: June 1, 2013
 - Voting Period Ends: July 1, 2013
 - Cycle 5, 2013
 - Ballot Submission Date: July 18, 2013
 - Voting Period Starts: July 29, 2013
 - Voting Period Ends: August 28, 2013
- SEMI Standards Publications
 - Standards published from January 2013 to March 2013:
 - New Standards: 9
 - Revised Standards: 14
 - Reapproved Standards: 2
 - Withdrawn Standards: 2
 - There are a total of 871 SEMI Standards in portfolio and that includes 93 Inactive standards
- Major Items Included in the Revision to the SEMI *Regulations*

- This revision to the *Regulations* added a new category called Complementary Files
 - Complimentary files are considered an official part of a standard or safety guideline
 - Complimentary files are NOT in PDF file format
 - Otherwise, they would be conjoined to the standard or safety guideline which are published in the PDF file format
 - They could be in any non-PDF format that is required for use with a standard or safety guideline
 - The TC Chapters decide which non-PDF files are complimentary
 - If they are not complimentary, then they are considered non-official and are categorized as *Various Materials*
 - If they are complimentary, then the files must be balloted if they are revised or added to a standard or safety guideline
- Other Major Items
 - Global Technical Committee Structure
 - All regional and local TC become chapters and are independent regardless of whether an RSC exist in their region
 - Formation and Disbandment of Global Technical Committee
 - Formation and Disbandment of TC Chapter under existing Global Technical Committee
 - Elimination of Regional Standards
 - Intellectual Property (IP) section (§15 in the *Regulations*)
 - There is now an exit mechanism for Letter of Assurances in “limbo”
 - More clarification for Letter of Intents and the discovery of IP after a standard is published
- Major Items Included in the Revision to the SEMI *Procedure Guide*
 - The *Procedure Guide* was revised to align with changes in the *Regulations*
 - Added the TFOF as Appendix 2
 - Addition of recommendation for author and/or the TF leader to distribute draft ballot to all TF members 7 days prior to Letter Ballot submission
- Global Activity Report
 - North America has the most TFs, SNARFs, and ballots followed by Japan and Europe
 - Please see the attached Staff Report for detailed information and other regions
- Request to Members
 - Looking for details on how standards are actually used:
 - Development/Engineering
 - Procurement
 - Manufacturing

- Interview should take less than 30 minutes – contact James Amano (jamano@semi.org) or any Standards staff

- SEMI N.A. contact: Michael Tran, mtran@semi.org

Attachment: 07, SEMI North America Standards Staff Report (CS MANTECH 2013)

4 Ballot Review

NOTE 1: Committee adjudication on the ballots are detailed in the Audits & Reviews (A&R) Subcommittee Forms for procedural review. These A&R forms are available as attachments to these minutes. The attachment number for each ballot document is provided under each ballot review section below.

Document #	Document Title	Committee Action
5544	Revision of SEMI M9.1-96E (Reapproved 0308), Standard for Round 50.8 mm Polished Monocrystalline Gallium Arsenide Wafers for Electronic Device Applications with title change to: Specification for Round 50.8 mm Polished Monocrystalline Gallium Arsenide Wafers for Electronic Device Applications	Passed as balloted. Superclean.
5545	Revision of SEMI M9.2-96E (Reapproved 0308), Standard for Round 76.2 mm Polished Monocrystalline Gallium Arsenide Wafers for Electronic Device Applications with title change to: Specification for Round 76.2 mm Polished Monocrystalline Gallium Arsenide Wafers for Electronic Device Applications	Passed as balloted. Superclean.
5546	Revision of SEMI M9.5-96E (Reapproved 0308), Standard for Round 100 mm Polished Monocrystalline Gallium Arsenide Wafers for Electronic Device Applications with title change to: Specification for Round 100 mm Polished Monocrystalline Gallium Arsenide Wafers for Electronic Device Applications	Passed as balloted. Superclean.
5547	Revision of SEMI M9.6-95E (Reapproved 0308), Standard for Round 125 mm Diameter Polished Monocrystalline Gallium Arsenide Wafers with title change to: Specification for Round 125 mm Diameter Polished Monocrystalline Gallium Arsenide Wafers	Passed as balloted. Superclean.

Motion: Documents 5544, 5545, 5546, and 5547 passed committee review as balloted and will be forwarded to the A&R SC for procedural review.

By / 2nd: Judy Kronwasser (NOVASiC) / Danh Nguyen (Lehightron Electronics)

Discussion: None.

Vote: 5-0 in favor. Motion passed.

Attachment: 08, Procedural Review for 5544

Attachment: 09, Procedural Review for 5545

Attachment: 10, Procedural Review for 5546

Attachment: 11, Procedural Review for 5547

5 Subcommittee & Task Force Reports

5.1 Gallium Nitride Task Force

5.1.1 Judy Kronwasser reported for the GaN Task Force. Judy has been working with Michael Tran on Document 4979, *New Standard: Specification for Polished Monocrystalline Gallium Nitride Wafers*. The document was distributed to the committee before balloting for feedback and while some comments were useful, some were not. Some key comments for changes in the document included:

- Increasing the thickness of the GaN wafer to 450, but for what diameter?
- Resolve discrepancy regarding flats orientation between one of the figures and the document text.
- Questioning lattice curvature spec, is it too large? The TF doesn't really know.
- Energy gap needs to be corrected to 3.48 eV.
- Correct the melting point to the atmospheric pressure.
- Remove option 2, 3 in Table A1-8 because off-orientation options are not relevant for Nitride.
- Omit the GaN growth technique as it might infringe on IP if you list the growth technique.
- Make the formatting of Table A1-3 consistent and list the limits.
- Reference section: remove DIN standards, other minor changes.

5.1.2 Judy will work with SEMI on what to do with the DIN standards. The committee commented that for a 2 inch GaN wafer with a thickness of 450 would make it extremely expensive. They would not go over 400 and suggested leaving it at 350.

5.1.3 Albert Davydov offered to help with the melting point because his background is in thermodynamics. Albert will send Judy the number for the melting point at atmospheric pressure. Albert will also help with the discrepancy of the flats orientation assuming if the flat of Gallium Nitride coincides with the flat for Sapphire then the orientations would be correct. Judy will send Albert the draft document to look at the flat orientation.

Attachment: 12, GaN TF Report (CS MANTECH 2013)

5.2 *Electrical Properties Task Force*

5.2.1 See § 3.1, ASTM F1.15 Subcommittee.

5.3 *Ge for PV Applications Task Force*

5.3.1 Jim Oliver reported for the Task Force. There have been no activities and Hani Badawi (AXT Inc.) requested to the committee to disband it.

Motion: To disband the Ge for PV Applications Task Force.

By / 2nd: Russ Kremer (Freiberger) / Danh Nguyen (Lehigh Electronics)

Discussion: None.

Vote: Unanimous in favor. Motion passed.

5.4 *SEMI M55 (Specification for Polished Monocrystalline Silicon Carbide Wafers) Task Force*

5.4.1 Judy Kronwasser reported for the M55 Task Force. Judy will await further word regarding the IP review of SEMI M55 from Arnd Weber.

5.5 *Silicon Carbide Task Force*

5.5.1 The TF is still looking for a TF leader. The TF deferred to the EU Silicon Carbide TF where the status of the IP checks were performed for the following documents:

- Document 3784A (SiC 100 mm)
 - The IP check failed
- Document 5370 (SiC 150 mm)
 - The initial IP check is done and technical discussion is in progress
- Five year review of SEMI M55

- A draft of M55 is under discussion and the IP checks are being considered. The TF provided feedback to Judy Kronwasser and the confirmation of edge contour (new) is open

5.5.2 For Document 3784A (100 mm SiC), the TF is waiting for Document 5370 (SiC 150 mm) to be completed first. Then they will review the technical contents of Document 3784A and remove some of the technical specifications that might be IP material.

Attachment: 13, EU SiC TF Report (CS MANTECH 2013)

6 Old Business

6.1 Five-Year Review

6.1.1 The committee reviewed documents due for their five year reviews:

#	Title	Status
SEMI M9.1-96E (Reapproved 0308)	Standard for Round 50.8 mm Polished Monocrystalline Gallium Arsenide Wafers for Electronic Device Applications	Passed committee and A&R SC review. Pending publication.
SEMI M9.2-96E (Reapproved 0308)	Standard for Round 76.2 mm Polished Monocrystalline Gallium Arsenide Wafers for Electronic Device Applications	Passed committee and A&R SC review. Pending publication.
SEMI M9.5-96E (Reapproved 0308)	Standard for Round 100 mm Polished Monocrystalline Gallium Arsenide Wafers for Electronic Device Applications	Passed committee and A&R SC review. Pending publication.
SEMI M9.6-95E (Reapproved 0308)	Standard for Round 125 mm Diameter Polished Monocrystalline Gallium Arsenide Wafers	Passed committee and A&R SC review. Pending publication.
SEMI M9.7-0708	Specification for Round 150 mm Polished Monocrystalline Gallium Arsenide Wafers (Notched)	Line item ballot to update the document to be submitted by Russ Kremer for Cycle 7-2013.

7 New Business

7.1 Upcoming Ballots

#	When	SC/TF/WG	Details
4979	Cycle 6 or 7-2013	Gallium Nitride (GaN) TF	New Standard: Specification for Polished Monocrystalline Gallium Nitride Wafers.

Motion: To ballot Document 4979 in cycle 6 or 7, 2013.

By / 2nd: Judy Kronwasser (NOVASiC) / Danh Nguyen (Lehightron Electronics)

Discussion: None.

Vote: Unanimous in favor. Motion passed.

8 Action Item Review

8.1 Open Action Items

8.1.1 Michael Tran (SEMI) reviewed the open action items. These can be found in the Open Action Items table at the beginning of these minutes.

8.2 New Action Items

8.2.1 Michael Tran (SEMI) reviewed the new action items. These can be found in the New Action Items table at the beginning of these minutes.

9 Next Meeting and Adjournment

9.1 The next NA Compound Semiconductor Materials meeting will be a virtual meeting via teleconference and web meeting. Meeting date, time and details when available will be announced to the committee and posted at the SEMI Standards Calendar of Events: <http://www.semi.org/en/Standards/CalendarEvents>

9.2 Having no further business, the meeting participants mutually agreed to adjourn the NA Compound Semiconductor Materials committee meeting in conjunction with CS MANTECH 2013 on May 15, 2013 in New Orleans, Louisiana.

Respectfully submitted by:

Michael Tran
Senior Standards Engineer
SEMI North America
Phone: 1-408-943-7019
Email: mtran@semi.org

Minutes approved by:

Jim Oliver (Northrop Grumman), Co-chair	September 4, 2013
Russ Kremer (Freiberger), Co-chair	September 4, 2013

Table 8 Index of Available Attachments #1

#	Title	#	Title
01	Required Meeting Elements	08	Procedural Review for 5544
02	NA CSM (CS MANTECH 2012) Meeting Minutes	09	Procedural Review for 5545
03	NA CSM Virtual Meeting Minutes (Fall 2012)	10	Procedural Review for 5546
04	ASTM F1.15 - GaN Update (CS MANTECH 2013)	11	Procedural Review for 5547
05	GaN HEMT Mobility Round Robin Update (CS MANTECH 2013)	12	GaN TF Report (CS MANTECH 2013)
06	EU CSM Report (CS MANTECH 2013)	13	EU SiC TF Report (CS MANTECH 2013)
07	SEMI North America Standards Staff Report (CS MANTECH 2013)		

#1 Due to file size and delivery issues, attachments must be downloaded separately. A .zip file containing all attachments for these minutes is available at www.semi.org. For additional information or to obtain individual attachments, please contact Michael Tran at the contact information above.