



# North America Compound Semiconductor Materials Committee Meeting Summary and Minutes

Virtual Meeting via Teleconference and Webmeeting Friday, November 15, 2013 1:00 PM to 3:00 PM (Eastern Time) 10:00 AM to 12:00 PM (Pacific Time)

#### **Next Committee Meeting**

The next N.A. Compound Semiconductor Materials technical committee meeting is tentatively scheduled for May 21, 2014 at the Sheraton Denver Downtown Hotel in Denver, Colorado, USA in conjunction with CS MANTECH 2014. Exact meeting date and details will be announced when finalized and available at the SEMI Calendar of Events: <u>http://www.semi.org/en/Standards/CalendarEvents</u>

#### **Table 1 Meeting Attendees**

Italics indicate virtual participants

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

#### SEMI Staff: Michael Tran

Company	Last	First	Company	Last	First
Freiberger	Kremer	Russ	NIST	Duff	Shannon
Lehighton Electronics	Nguyen	Danh	Northrop Grumman	King	Matt
Lehighton Electronics	Blew	Austin	Northrop Grumman	Oliver	Jim
NIST	Almond	Neil	NOVASiC	Kronwasser	Judy
NIST	Davydov	Albert	WEQ Consulting	Quinn	William
			SEMI N.A.	Tran	Michael

# **Table 2 Leadership Changes**

None.

#### **Table 3 Ballot Results**

None.

# **Table 4 Authorized Activities**

None.

# **Table 5 Authorized Ballots**

None.

#### **Table 6 New Action Items**

Item #	Assigned to	Details	
2013Nov#01	Michael Tran	Work with Judy Kronwasser on Document 4979 (Polished Monocrystalline GaN Wafers)	
2013Nov#02	Michael Tran	Work with Arnd Weber for Document 5370 (Revision to add a subordinate standard to SEMI M55, 150 mm SiC Wafer Specification) to be balloted in Cycle 8, 2013	
2013Nov#03	Albert Davydov	Send NIST reference material for Silicon to Danh Nguyen	
2013Nov#04	Judy Kronwasser	Complete and ballot document (Polished Monocrystalline GaN Wafers) by Cycle 2, 2014	





#### Table 6 New Action Items

Item #	Assigned to	Details
2013Nov#05	Michael Tran/Russ Kremer	Coordinate logistics for the NA CSM Meeting in conjunction with CS MANTECH 2014

#### Table 7 Previous Meeting Actions Items

Item #	Assigned to	Details	Status
2013May#01	Albert Davydov	Send Judy Kronwasser the number for the melting point at atmosphere pressure for Document 4979 (Specification for Gallium Nitride).	CLOSED.
2013May#02	Albert Davydov	Assist Judy Kronwasser with the flats orientation of Gallium Nitride and Sapphire in Document 4979.	CLOSED.
2013May#03	Michael Tran	Work with Judy Kronwasser on DIN standards being referenced in Document 4979.	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 10:00 AM PST. 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 minutes of the previous meeting in conjunction with CS MANTECH 2013. However, due to SEMI Regulations, virtual participants could not vote on the motion to approve the minutes from the previous meeting will be approved at the next committee meeting in conjunction with CS MANTECH 2014.

#### 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 Matt King (Northrop Grumman) and Albert Davydov (NIST) reported for the F1.15 GaN Epitaxial Wafer Reference Material Task Force. Of note:

- The TF obtained results for the Hall measurements on the samples:
  - 1) GaN on sapphire samples for testing:
    - Supplier 1. One 3" wafer: 3 µm thick GaN (0001) layer on c-sapphire; unintentionally doped
    - Supplier 2. Two 2" wafers: 8 µm thick GaN (0001) layers on c-sapphire; one is unintentionally doped and one is Si-doped
- The TF will carry on with its testing of non-destructive and destructive methods for electrical, optical and microstructural on the samples obtained
  - electrical: Eddy-current; Hall; C-V, CTLM;





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

Attachment: 02, Agenda for ASTM F1.15

### 3.1.2 GaN HEMT Mobility Round Robin

3.1.2.1 Danh Nguyen (Lehighton Electronics) reported for the GaN HEMT Mobility Round Robin. Of note:

- II-VI Incorporated sent five samples of their 3" Silicon Carbide substrates
- Dr. Xiang Ming Pan (IQE-RF) will assist with growing the Epi
- Round Robin Work Group
  - o The first round: non-contact / non-destructive measurement on wafers such as GaN on SiC
  - The second round: wafers will be cleaving into 10 x10 mm with ohmic for measure by Destructive Hall measurements
    - The round robin needs help in developing procedures for cleaving the wafers and making contacts
    - Volunteers are welcomed to confirm, test schedules and condition for non-destructive / destructive testing
    - Please contact the round robin leader, Danh Nguyen at <u>danh@lehighton.com</u> or 610-377-5990
- Neil Almond (ASTM) commented he did not fully understand the procedure for non-destructive measurement
  - He understands that for non-destructive measurement means you can take whatever specimen you got and measure it multiple times in with in a lab or another lab
- However, he was not that familiar with the measurement procedure to create a test result:
  - First issue is what do you go through in terms of observation to create the final result that you would publish or use on an individual basis?
  - Do you look at multiple sites or averaging each site's results or tracking each site's results separately?
- The next issue is the idea of repeatability:
- You have a lot of labs and a bunch of material specimens that you can create independently and you don't need a lot of repeatability on each sample.
  - Perhaps repeating the testing 2-3 times at most on the material would be ideal in terms of a given location
- Danh said the Round Robin is working with Albert and NIST in terms of having the proper materials for the tests
  - Second the test procedures are based on NIST reference materials and they will determine the test method for the GaN materials soon for non-destructive and destructive methods
  - Danh agrees that creating a standard resulting from the different materials being used to all the variations in procedures, techniques, and equipment for the tests is difficult
  - What do you based the test results off initially?
- Neil said since the same materials are being used by various labs, all the different procedures, techniques, and equipment can be brought all together to see if there are any biases between the different methods presuming the material is stable and won't be destroyed during the tests.





- That's the whole idea of having a reference so the labs can recalibrate should the results are different
- Danh said that NIST might have a reference material for Silicon that could be used
  - Albert will check to see if there is a Reference Material for Silicon. The GaN materials are different from Silicon so some methods may not be correct but having a Silicon reference may help as some properties are the same.
- Neil said there is still a concern with the repeatability and reproducibility of the test results like say between suppliers and end users since different equipment is being used for example.
  - Everyone agreed that is a concern and agreed to continue the discussion in a TF meeting offline.

Attachment: 03, GaN HEMT Mobility Round Robin Update

#### 3.2 Europe Compound Semiconductor Materials Committee

- 3.2.1 There was no report received
  - SEMI EU Contact, Yann Guillou (yguillou@semi.org)

#### 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:
  - SEMI Major Events in 2013
    - Completed:
      - SEMICON Europa in conjunction with Plastic Electronics Exhibition 2013
        - October 8-10, 2013 in Dresden, Germany
      - Strategic Materials Conference
        - October 16-17, 2013 in Santa Clara, California
    - PV Taiwan 2013
      - October 30-November 1, 2013 in Taipei
    - o SEMICON Japan
      - December 4-6, 2013 in Chiba
  - SEMI Major Events in 2014
  - European 3D TSV Summit
    - January 21-22, 2014 in Grenoble, France
  - SEMICON Korea / LED Korea
    - o February 12-14, 2014 in Seoul
  - SEMICON China
    - o March 18-20, 2014 in Shanghai
  - SEMICON Singapore

# Semi



- o April 23-25, 2014 in Marina Bay Sands
- SEMICON West
  - o July 8-10, 2014 in San Francisco, California
- SEMI Standards Publications
  - Standards published from July 2013 to September 2013:
    - New Standards: 5
    - Revised Standards: 19
    - Reapproved Standards: 9
    - Withdrawn Standards: 0
  - o There are a total of 892 SEMI Standards in portfolio and that includes 98 Inactive standards
- New Cycle 8 Voting Period (tentative)
  - Cycle 8, 2013
    - Ballot Submission Date: Nov 15, 2013
    - Voting Period Starts: Nov 29, 2013
    - Voting Period Ends: Dec 31, 2013
- Upcoming North America Standards Meetings in 2014
  - NA Standards Spring 2014 Meetings
    - March 31 April 3, 2014 at SEMI HQ in San Jose, California
- Standards Usage Interview
  - 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)
- Official SEMI Standards Groups
  - o LinkedIn
    - http://www.linkedin.com/groups/Official-SEMI-Standards-Group-1774298/about
  - o Twitter
    - @SEMI\_standard
- SEMI N.A. contact: Michael Tran, <u>mtran@semi.org</u>
- Attachment: 04, SEMI North America Standards Staff Report

#### 4 Ballot Review

4.1 None.

#### 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 on document 4979 (Polished Monocrystalline GaN Wafers) incorporating feedback from the industry from the last meeting. Judy will work with Michael Tran to complete the document and it will be balloted in Cycle 1 or 2, 2014.

5.1.2 There were questions about thickness of various diameters for GaN. Albert Davydov responded:

5.1.2.1 For bulk substrates there are two types – one is still attached to the substrates. 20 to 100 microns thick for semi-bulk still attach to the substrate. For freestanding GaN probably 500 microns to an mm thickness. Albert can't comment on the cost. For freestanding diameter the target 250 mm some companies 10 by 10 mm squared or 2 in.

# 5.2 Electrical Properties Task Force

5.2.1 See § 3.1, ASTM F1.15 Subcommittee.

# 5.3 SEMI M55 Task Force

5.3.1 The TF is will await further word regarding the IP review of SEMI M55 from Arnd Weber (SiCrystal). Russ Kremer noted SEMI M55 will be virtually nothing and almost useless once all the IP Materials from Cree are taken out of the document. Michael Tran will work with Russ on a SNARF to revise M55 to take out the IP materials.

#### 5.4 Silicon Carbide Task Force

5.4.1 The TF is still looking for a TF leader. The TF deferred to the EU Silicon Carbide TF where most of the SiC activities have been occurring:

- The TF is still looking for a TF leader
- The TF deferred to the EU Silicon Carbide TF where most of the SiC activities have been occurring
  - The EU Silicon Carbide TF reviewed Intellectual Property (IP) for the SiC 100 mm and SiC 150 mm documents
  - Document 5370 (Revision to add a subordinate standard to SEMI M55, 150 mm SiC Wafer Specification) was balloted in Cycle 8-13
  - Document 3784E (100 mm SiC Wafer Specification) is currently being drafted and will be balloted sometime in 2014

Attachment: 05, EU SiC 150 mm TF Meeting Minutes

# 6 Old Business

#### 6.1 Five-Year Review

6.1.1 There were no documents needing five year reviews from the NA Compound Semiconductor Materials TC Chapter.

#### 7 New Business

7.1 None





# 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 N.A. Compound Semiconductor Materials Technical Committee Sheraton Denver Downtown Hotel in Denver, Colorado, USA
Wednesday, May 21, 2014
\*7:00 PM - 9:00 PM (MST), 6:00 PM - 8:00 PM (PST), 9:00 PM to 11:00 PM (EST)

\*Times and dates are subject to change without notice.

More information will be updated at http://www.semi.org/en/Standards/CalendarEvents

9.2 Having no further business, the virtual meeting participants mutually agreed to adjourn the NA Compound Semiconductor Materials virtual committee meeting on November 15, 2013.

Respectfully submitted by:

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

Minutes approved by:

Jim Oliver (Northrop Grumman), Co-chair	
Russ Kremer (Freiberger), Co-chair	May 2, 2014

#### Table 8 Index of Available Attachments #1

#	Title	#	Title
01	Required Meeting Elements		
02	Meeting Agenda for ASTM F1.15		
03	GaN HEMT Mobility Round Robin Update		
04	SEMI North America Standards Staff Report		
05	EU SiC 150 mm TF Meeting Minutes		

#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.