North America 3DS-IC (Three-dimensional Stacked Integrated Circuits) Standards Committee Meeting Summary and Minutes

NA Standards Fall 2014 Meetings
4 November, 15:00 – 17:00 Pacific Time
SEMI Headquarters in San Jose, California

Committee Announcements
Next Committee Meeting
North America Standards Spring 2015 Meetings
March 31, 2015
SEMI Headquarters in San Jose, California

Table 1 Meeting Attendees

Italics indicate virtual participants

Co-Chairs: Urmi Ray (Qualcomm), Sesh Ramaswami (Applied Materials), Richard Allen (NIST), Chris Moore (BayTech-Resor)

SEMI Staff: Paul Trio

Company	*Last*	*First*	*Company*	*Last*	*First*
Asahi Glass	Takahashi	Mark	Corning	Schmidt	Ilona
BayTech-Resor	Baylies	Win	NIST	Allen	Richard
BayTech-Resor	Moore	Chris	Sonoscan	Martell	Steve
BW & Associates	Wu	Bevan	SuperSight	Perroots	Len
Consultant	*Read*	*David*	SEMI	Trio	Paul

Table 2 Leadership Changes

Group	*Previous Leader*	*New Leader*
North America 3DS-IC TC Chapter	Urmi Ray (Qualcomm) stepped down as committee cochair.	
The Thin Wafer Handling Task Force has been 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.

Document #	*Document Title*	*Committee Action*
5270	New Standard: Guide for Measuring Voids in Bonded Wafer Stacks	**Passed** with editorial changes.
5506A	New Standard: Guide for Measuring Flatness and Shape of Low Stiffness Wafers	**Passed** with editorial changes.
5616	Revision to SEMI 3D4, Guide for Metrology for Measuring Thickness, Total Thickness Variation (TTV), Bow, Warp/Sori, and Flatness of Bonded Wafer Stacks	**Passed** as balloted. Superclean

Table 4 Authorized Activities

#	Type	SC/TF/WG	Details
5822	SNARF	Inspection & Metrology TF	New Standard: Specification for Reference Material for Bonded Wafer Stack Void Metrology
5823	SNARF	Bonded Wafer Stack TF	Revision to SEMI 3D2, Specification for Glass Carrier Wafers for 3DS-IC Applications

Note: SNARFs and TFOFs are available for review on the SEMI Web site at:
http://downloads.semi.org/web/wstdsbal.nsf/TFOFSNARF

Table 5 Authorized Ballots

#	When	SC/TF/WG	Details
None			

Table 6 New Action Items

Item #	Assigned to	Details
2014Nov #01	Paul Trio	Look into breakdown of document subtypes (e.g., # Specifications vs # Guides) of currently published SEMI Standards
2014Nov #02	Paul Trio	Notify NA 3DS-IC TC members of ongoing activities in 3DS-IC Taiwan and Japan.
2014Nov #03	Paul Trio	Notify 3DS TC members that the Thin Wafer Handling TF has been disbanded due no ongoing activities.
2014Nov #04	Paul Trio, Kris Shen	Work with sputter targets proposers to identify appropriate standards developing organization (SDO) to carry out the activity

Table 7 Previous Meeting Actions Items

Item #	Assigned to	Details
2014Jul #01	Rich Allen, Paul Trio	Discuss how best to structure 5173F document (e.g., adding a note) since it will require M1 to implement.
2014Jul #03	Paul Trio	Arrange for access to SEMI HB1 for Victor Vartanian (SEMATECH)
2014Jul #06	Yaw Obeng	Provide university contacts for 3D-IC packaging standardization gaps survey.
2014Jul #07	Paul Trio	Send 3D-IC packaging gaps survey form to global 3D-IC committee members for feedback.

1 Welcome, Reminders, and Introductions

Rich Allen, committee co-chair, called the meeting to order at 3:00 PM. After welcoming all attendees, the SEMI meeting reminders on membership requirements, antitrust, patentable technology, and meeting guidelines were presented and explained. Finally, the agenda was reviewed.

Attachment: 01, SEMI Standards Required Meeting Elements

2 Review of Previous Meeting Minutes

The committee reviewed the minutes of the previous meeting held July 8 in conjunction with SEMICON West 2014. Ilona Schmidt's name entry in the attendee list was corrected.

Motion: Accept the minutes of the previous meeting as amended.
By / 2nd: Chris Moore (BayTech-Resor) / Win Baylies (BayTech-Resor)
Discussion: None
Vote: 6-0 in favor. Motion passed.

Attachment: 02, Amended NA 3DS-IC SEMICON West 2014 meeting (July 8) minutes

3 SEMI Staff Report

Paul Trio (SEMI) gave the SEMI Staff Report. The key items were as follows:

- 2014 Global Calendar of Events
  - International Technology Partners Conference [ITPC] (November 9-12, Big Island, Hawaii)
  - Collaborative Alliance for Semiconductor Test [CAST] Workshop: Implementing Next Generation Data Logging (November 12-13, San Jose, California)
  - SEMI South America Semiconductor Strategy Summit (November 18-20, Buenos Aires, Argentina)
  - SEMICON Japan (December 3-5, Tokyo)
- 2015 Global Calendar of Events
  - Industry Strategy Symposium (January 11-14, Half Moon Bay, California)
  - European 3D TSV Summit (January 19-21, Grenoble, France)
  - SEMICON Korea / LED Korea (February 4-6, Seoul)
  - Industry Strategy Symposium [ISS] Europe (February 22-24, Amsterdam, Netherlands)
  - SEMICON China / FPD China (March 17-19, Shanghai)
  - LED Taiwan (March 25-28, Taipei)
  - SEMICON Southeast Asia (April 22-24, Penang, Malaysia)
  - Advanced Semiconductor Manufacturing Conference [ASMC] (May 3-6, Saratoga Springs, New York)
  - Intersolar Europe (June 10-12, Munich Germany)
  - SEMICON Russia (June 17-18, Moscow)
  - SEMICON West (July 14-16, San Francisco, California)
  - SEMICON Taiwan (September 2-4, Taipei)
  - European MEMS Summit (September 17-18, Milan, Italy)
  - SEMICON Europa (October 6-8, Dresden, Germany)
  - SEMICON Japan (December 16-18, Tokyo)
- NA Standards Fall 2014 Meetings (November 2-6)
  - Committees meeting at SEMI Headquarters (San Jose)
    - 3DS-IC | EHS | Facilities & Gases | HB-LED | Information & Control | Liquid Chemicals | MEMS/NEMS | Metrics | PV Materials
  - SEMI thanks Intel (Santa Clara) for hosting the Physical Interfaces & Carriers (PIC) and Silicon Wafer committees.

- SEMI Standards Publications
    - July 2014 Cycle
        - New Standards – 1, Revised Standards – 6, Reapproved Standards – 0, Withdrawn Standards – 1
    - August 2014 Cycle
        - New Standards – 2, Revised Standards – 7, Reapproved Standards – 0, Withdrawn Standards – 0
    - September 2014 Cycle
        - New Standards – 2, Revised Standards – 7, Reapproved Standards – 1, Withdrawn Standards – 1
    - October 2014 Cycle
        - New Standards – 3, Revised Standards – 9, Reapproved Standards – 1, Withdrawn Standards – 0, Total in portfolio – 917 (includes 108 Inactive Standards)
- NA Standards Spring 2015 Meetings
    - March 30 – April 2 at SEMI Headquarters (San Jose, California)
    - Inviting local companies willing and able to host some of the meetings to help maintain one-week format.
- Upcoming North America Meetings (2015)
    - NA Standards Spring 2015 Meetings (March 30 – April 2, San Jose, California)
    - NA Compound Semiconductor Materials TC Chapter Meeting (May 20 in conjunction with CS MANTECH, Scottsdale, Arizona)
    - NA Standards Meetings at SEMICON West 2015 (July 13-16, San Francisco, California)
    - NA Standards Fall 2015 Meetings (November 2-5, San Jose, California)

Action Item: 2014Nov #01, Paul Trio to look into breakdown of document subtypes (e.g., # Specifications vs # Guides) of currently published SEMI Standards.

Attachment: 03, SEMI Standards Staff Report

4 Taiwan 3DS-IC Committee

Paul Trio (SEMI) provided an update on Taiwan 3DS-IC activities.

- Leadership Changes
    - Committee Chair
        - Roger Huang (ASE) was appointed TC Chapter cochair
    - Testing Task Force
        - Li-Heng Lee (ITRI) was appointed as new TF co-leader.
- Issued Ballots (Cycle 7, 2014 Voting Period)
    - Doc. 5485, New Standard: Guide for Incoming/Outgoing Quality Control and Testing Flow for 3DS-IC Products
    - Doc. 5688, New Standard: Guide For Overlay Performance Assessment For 3DS-IC Process
- New SNARF
    - New Standard: Guide for Wafer Edge Trimming for 3DS-IC Process (#5800)
        - Description: 3DS-IC wafer edge trimming process is a key step for successful wafer thinning after the wafer bonded in the 3DS-IC process. Therefore, the guide will provide a feasible approach to perform the wafer edge trimming. This guide will address the specs

of edge trimming and resultant particle count to ensure the successful wafer thinning process after the wafer edge trimming.

  - Task Force: Middle-End Process TF

- Next meeting: January 15 at SEMI Taiwan office.
- SEMI Staff:
  - Andy Tuan | atuan@semi.org

Attachment: 04, Taiwan 3DS-IC Report

5 Japan Packaging Committee

Paul Trio provided the Japan 3D-IC liaison report under the JA Packaging Committee. The key items were as follows:

- Next meeting: January 20 during the Japan Winter Meetings 2015 (SEMI Japan office, Tokyo)
- Thin Die Bending Strength Measurement Method Task Force
  - Doc. 5691, New Standard: Test Method for Measurement of Chip (Die) Strength by Mean of Cantilever Bending
    - Passed committee and ISC A&R reviews. Published as SEMI G96-0914
  - TF is planning to submit technical paper to Japan Institute of Electronics Packaging (JIEP) Proceedings.
- Thin Chip Handling Task Force
  - Working for the contents of SNARF. The 1st draft of the following 2 items were submitted. But, they should be discussed more:
    - Adhesive Strength Test Method for Adhesive Tray Used for 3D-IC Manufacturing and Shipping
    - Specification for adhesive Tray Used for 3D-IC Manufacturing and Shipping
- 3D-IC Study Group
  - Study Group meeting is being held actively
    - Aug. 29, 2012: Workshop with 20 attendees
    - Oct. 5, 2012: Kick Off Meeting with 20 attendees
    - Nov. 7, 2012: 2nd Meeting with 14 attendees
    - Dec. 6, 2012: 3rd Meeting with 31 attendees
    - Feb. 1, 2013: 4th Meeting with 17 attendees
    - Mar. 7, 2013: 5th Meeting with 28 attendees
    - Mar. 26, 2013: 6th Meeting with 21 attendees
    - Apr. 26, 2013: 7th Meeting with 16 attendees
    - May. 17, 2013: 8th Meeting with 18 attendees
    - Jun. 27, 2013: 9th Meeting with 17 attendees
    - Sep. 19, 2013: 10th Meeting with 13 attendees
    - Oct. 22, 2013: 11th Meeting with 24 attendees
    - Nov. 28, 2013: 13rd Meeting with 22attendees
    - Dec. 5, 2013: 14th Meeting with 22 attendees
    - Dec. 19, 2013: 15th Meeting with 15 attendees
    - Jan. 13, 2014: 16th Meeting with 18 attendees
    - Mar. 11, 2014: 17th Meeting with 21 attendees
    - May 8, 2014: 18th Meeting with 21 attendees
    - Jul. 14: 19th Meeting with 25 attendees

        - Sep. 29: 20th meeting with 18 attendees
    - Discussing about setting up "Tape Adhesive Strength Measurement TF". TFOF will be submitted to GCS or the next committee meeting.
    - The Global Meeting with NA and TW members will be held during SEMICON Japan 2014.
- SEMI Staff:
    - Naoko Tejima | ntejima@semi.org

Action Item: 2014Nov #02, Paul Trio to notify NA 3DS-IC TC members of ongoing activities in 3DS-IC Taiwan and Japan.

Attachment: 05, Japan 3D-IC Report

6 Ballot Review

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.

NOTE 1:Committee adjudication on Cycle 6 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 document is provided below the summary tables.

6.1 *Cycle 6 Ballots*

Document #	*Document Title*	*Committee Action*
5270	New Standard: Guide for Measuring Voids in Bonded Wafer Stacks	**Passed** with editorial changes.
5506A	New Standard: Guide for Measuring Flatness and Shape of Low Stiffness Wafers	**Passed** with editorial changes.
5616	Revision to SEMI 3D4, Guide for Metrology for Measuring Thickness, Total Thickness Variation (TTV), Bow, Warp/Sori, and Flatness of Bonded Wafer Stacks	**Passed** as balloted. Superclean

Attachment: 06, Ballot Review for Doc. 5270

07, Ballot Review for Doc. 5506A

08, Ballot Review for Doc. 5616

7 Task Force Reports

7.1 *Bonded Wafer Stacks Task Force*

Rich Allen reported that the task force is continuing work on the following Documents:

- Doc. 5173F – New Standard: Guide for Describing Silicon Wafers for Use in a 300 mm 3DS-IC Wafer Stack
- Doc. 5174 – New Standard: Specification for Identification and Marking for Bonded Wafer Stacks
- Doc. 5692 – New Standard: Guide for Describing Glass Wafers for Use as 300 mm Carrier Wafers in a 3DS-IC Temporary Bond-Debond (TBDB) Process
- Doc. 5713 – New Standard: Specification of Glass Interposers

With regard to Document 5692, the TF discussed that its scope may be too close to SEMI 3D2 (*Specification for Glass Carrier Wafers for 3DS-IC Applications*), but have not yet decided whether or not to discontinue the activity.

7.2 *Inspection & Metrology Task Force*

The task force prepared a new SNARF to develop a specification for reference material for bonded wafer stack metrology. See section 9.2.1 of these minutes for additional discussion.

7.3 *Thin Wafer Handling Task Force*

As there were no foreseeable new activities anticipated, the committee discussed disbanding the TF. The Thin Wafer Handling Task Force was responsible for the development of SEMI 3D3, Guide for Multiwafer Transport and Storage Containers for 300 mm, Thin Silicon Wafers on Tape Frames.

Motion: NA 3DS-IC TC Chapter approves to disband the Thin Wafer Handling Task Force.
By / 2nd: Chris Moore (BayTech-Resor) / Win Baylies (BayTech-Resor)
Discussion: None
Vote: 5-0 in favor. Motion passed.

Action Item: 2014Nov #03, Paul Trio to notify 3DS-IC TC members that the Thin Wafer Handling TF has been disbanded due no ongoing activities.

8 Old Business

8.1 Action Items from previous meeting:

Item #	*Assigned to*	*Action Item*	*Status*
2014Jul #01	Rich Allen, Paul Trio	Discuss how best to structure 5173F document (e.g., adding a note) since it will require M1 to implement.	Open
2014Jul #02	Dave Read	Draft a SNARF for the new Auxiliary Information document related to the SNARF #5270 activity for GCS approval.	Completed. Closed.
2014Jul #03	Paul Trio	Arrange for access to SEMI HB1 for Victor Vartanian (SEMATECH)	Open
2014Jul #04	Paul Trio	Send editable version of SNARF #5616 to Victor Vartanian (SEMATECH)	Completed. Closed.
2014Jul #05	Rich Allen, Victor Vartanian	Contact Steve Olson regarding Thin Wafer TF participation.	Closed.
2014Jul #06	Yaw Obeng	Provide university contacts for 3D-IC packaging standardization gaps survey.	Open
2014Jul #07	Paul Trio	Send 3D-IC packaging gaps survey form to global 3D-IC committee members for feedback.	Open
2013Jul #02	Paul Trio	Remind Rich Allen to look into renaming the Thin Wafer Handling Task Force to Thin Wafer Task Force then form appropriate working groups focusing on various areas (e.g., Handling WG, Shipping WG).	Closed.

9 New Business

9.1 *Approval of New Auxiliary Information: Round Robin Study of Method for Measurement of Voids in Bonded Pairs of Silicon Wafers (Doc #5766)*

Developed by the Inspection & Metrology Task Force, the Auxiliary Information was created to archive the experimental inspection data contributed in support of SEMI Draft Document 5270, New Standard: Guide for Measuring Voids in Bonded Wafer Stacks. Issued for the Cycle 6, 2014 voting period and approved during the NA 3DS-IC Fall 2014 Meeting (November 4), Ballot 5270 summarizes the results of an experimental round-robin type study to evaluate the capabilities of various technologies to resolve voids between bonded wafers. The measurements were performed on specimens consisting of bonded wafer pairs (BWP) with programmed bond voids.

An experimental protocol, including a master data reporting form, was written. Volunteer participants inspected the BWP using their preferred method. Each report included filled-in data reporting forms; some participants reported additional information including images. The 5270 Guide document extracts the essential information from these reports, but it does not contain the raw data. These raw data are archived in the proposed document, so that they can be available for future reference.

Motion:	Approve Document 5766, New Auxiliary Information: *Round Robin Study of Method for Measurement of Voids in Bonded Pairs of Silicon Wafers.*
By / 2nd:	Ilona Schmidt (Corning) / Bevan Wu (BW & Associates)
Discussion:	None
Vote:	5-0 in favor. Motion passed.

Attachment: 09, SEMI Draft Document 5766, *New Auxiliary Information: Round Robin Study of Method for Measurement of Voids in Bonded Pairs of Silicon Wafers*

9.2 *New TFOFs & SNARFs*

9.2.1 *New Activity on Reference Material for Bonded Wafer Stack Void Metrology*

Steve Martell presented to the committee a proposal for a new Specification for Reference Material for Bonded Wafer Stack Void Metrology:

- Rationale: The Guide for Measuring Voids in Bonded Wafer Stacks (SEMI Draft Document 5270) is soon to be published as a 3DS-IC Standard. Document 5270 summarizes the state of the art in 2013/2014 for void detection. Going forward, a test sample of known void dimensions will be needed for metrology system development and calibration. This SNARF describes a document which will be used to create such a sample.
- Scope: Document will describe requisite test structures, including design, manufacturing, and certification procedure.

Motion:	Approve new SNARF for: Specification for Reference Material for Bonded Wafer Stack Void Metrology.
By / 2nd:	Steve Martell (Sonoscan) / Chris Moore (BayTech-Resor)
Discussion:	None
Vote:	6-0 in favor. Motion passed.

9.2.2 *New Activity on SEMI 3D2 Revision*

Mark Takahashi presented a new SNARF to revise SEMI 3D2 (*Specification for Glass Carrier Wafers for 3DS-IC Applications*) for committee review and approval:

- Rationale: SEMI 3D2-1113 was originally developed to provide the framework for ordering Glass Wafers for the application of carrier wafer for processing device wafers for 3D stacking. As this technology has matured, the requirements for such carrier wafers have become more clear and weaknesses in 3D2-1113 have been identified.

  This activity aims to revise SEMI 3D2-1113 to address the following weaknesses:

  1. Update or eliminate specifications that are unnecessarily stringent for 3D stacked applications
  2. Allow for additional glass types that were not permitted in 3D2-1113, yet meet industry requirements for 3D stacked applications.

  This Document development activity is expected to result in a major revision of 3D2.

- Scope: Table 1 of 3D2 is a template for ordering glass carrier wafers for 3DS-IC applications. Most entries currently have “suggested” values, with optional “other” values. Each entry will be evaluated to see if the current suggested value either:
  1. No longer represent current industry requirements
  2. Favor a particular technology or supplier.

  This Draft document will address entries that fail one or both of these tests and will, as needed modify the definitions in section 7 to reflect these changes.

Motion:	Approve new SNARF for: Revision to SEMI 3D2, Specification for Glass Carrier Wafers for 3DS-IC Applications.
By / 2nd:	Mark Takahashi (AGC) / Chris Moore (BayTech-Resor)
Discussion:	None
Vote:	5-0 in favor. Motion passed.

9.3 *New Standard Proposal on High-purity Titanium (or Copper) Sputtering Target used for TSV Metallization*

Paul Trio presented a new standards activity proposal originating from the China region. The proposal aims to develop a guide for high-purity titanium (or copper) sputtering target used for TSV metallization. The SNARF was submitted by Dr. Tingyu Lin (National Centre for Advanced Packaging) and Dr. Jin Jiang He (Grikin Advanced Materials):

- Rationale: Sputtering target purity, grain size, inner quality, bonding, dimension and appearance specifications are included in this standard along with reference for qualification test methods. Reliability, certification, traceability, and packaging requirements are also included. Existing standards are too simple and may negatively impact quality and reliability during TSV manufacturing process if strict controlling is not fully implemented. The customers, e.g., ASE, Spil, JCAP, Fujitsu, Hua Tian technology, etc will be more beneficial on good quality and reliability performance if new task forces will be implemented.
- Scope: Sputtering target purity, grain size, inner quality, bonding, dimension and appearance specifications are included in this standard along with reference for qualification test methods. Reliability, certification, traceability, and packaging requirements are also included.

Upon reviewing the SNARF, the committee believes that an existing ASTM standard (F1709, *Standard Specification for High Purity Titanium Sputtering Targets for Electronic Thin Film Applications*) already addresses this topic. The committee is requesting the SNARF submitters to provide information on how their proposal is different from the ASTM F1709 standard. If ultimately this proposal aligns closely with ASTM activities, the committee encouraged the SNARF submitters to work with ASTM in their proposal.

Action Item: 2014Nov #04, Paul Trio and Kris Shen to work with sputter targets proposers to identify appropriate standards developing organization (SDO) to carry out the activity.

10 Action Item Review

10.1 *Open Action Items*

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

10.2 *New Action Items*

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

11 Next Meeting and Adjournment

The next meeting of the North America 3DS-IC committee is scheduled for Tuesday, March 31 in conjunction with the NA Standards Spring 2015 Meetings in San Jose, California. The tentative schedule is provided below:

North America Standards Spring 2015 Meetings
March 30 to April 2
SEMI Headquarters
3081 Zanker Road
San Jose, California 95134
U.S.A.

Tuesday, March 31

- Inspection & Metrology Task Force (8:00 AM to 10:00 AM)
- Bonded Wafer Stacks Task Force (10:00 AM to 12:00 Noon)
- NA 3DS-IC Committee (1:00 PM to 3:00 PM)

Having no further business, a motion was made to adjourn the NA 3DS-IC Committee meeting in conjunction with the NA Standards Fall 2014 meetings. Adjournment was at 5:40 PM.

Respectfully submitted by:
Paul Trio
Senior Manager, Standards Operations
SEMI North America
Phone: +1.408.943.7041
Email: ptrio@semi.org

Minutes approved by:

Richard Allen (NIST), Co-chair	March 3, 2015
Chris Moore (BayTech-Resor), Co-chair	
Sesh Ramaswami (Applied Materials), Co-chair	Not present
Urmi Ray (Qualcomm), Co-chair	Not present

Table 8 Index of Available Attachments #1

#	*Title*
1	SEMI Standards Required Meeting Elements
2	Amended NA 3DS-IC West 2014 Meeting (July 8) Minutes
3	SEMI Standards Staff Report
4	Taiwan 3DS-IC Report
5	Japan 3D-IC Report
6	Ballot Review for Doc. 5270
7	Ballot Review for Doc. 5506A
8	Ballot Review for Doc. 5616
9	SEMI Draft Document 5766, *New Auxiliary Information: Round Robin Study of Method for Measurement of Voids in Bonded Pairs of Silicon Wafers*

#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 Paul Trio at the contact information above.