STANDARDS NEW ACTIVITY REPORT FORM (SNARF)

Date Prepared: February 1, 2016 *Revised (if Applicable):* October 12, 2018

SNARF for: ~~Specification~~Guide for ~~a~~Use of Test ~~Pattern~~Patterns for Characterizing a Deep Reactive Ion Etching (DRIE) Process ~~Characterization~~

Originating Global Technical Committee: MEMS/NEMS

Originating TC Chapter: North America

Task Force (TF) in which work is to be carried out: MEMS Material Characterization

Submitted by: Richard Allen ***Company:*** NIST

Email: richard.allen@nist.gov

Phone: 301.975.5026 ***Fax:***

Refer to *Procedure Manual* § 2.2.4 for more information on properly filling out the SNARF.

1. Rationale:

a: Describe the need or problem addressed by this activity.

(Indicate the customer, what benefits they will receive, and if possible, quantify the impact on the return on investment [ROI] if the Document is implemented.)

Deep Reactive Ion Etching (DRIE) is widely used in MEMS processes for fabricating high-aspect ratio features. However, each tool type – and often each chamber – has unique recipe settings for optimum etch performance for each material. These settings include gas flows, duration, temperature profile, etc. A designer does typically not know these variables before bringing a design to the foundry. ~~–~~Further, the performance is dependent on open area (OA), i.e., the amount of area subject to the etch process. The OA can range from 1% to 100% (blanket etch). These variables lead to significant costs to both designer and foundry, as the process must be tuned to the specific design and material combination, before production can commence.

~~A~~Currently, the designer may not have information on how a specific tool at their foundry of choice may perform and it is common that unexpected etch results lead to missed performance target on first silicon. That is, since the designer is limited to using best known methods to achieve the desired feature sizes, the results may not meet requirements.

The guide would provide a standard family of test patterns, with OA ranging from 1% to ~~100%, would~~ approximately 50%, to simplify process evaluation ~~and~~, allowing the designer to use the test pattern in a short-loop process. The results of the short-loop would allow ~~foundry~~ the designer to modify their layout to ensure verify that they achieve the desired geometry, with a reduction in time and ~~their customers to know in advance the performance of a specific tool for a particular~~expense to first functional chips.

MEMS foundries can implement this test pattern, allowing them to incorporate the results into their design~~, reducing~~ guidelines, eliminating the need for ~~a series of experiments to accompany each new~~customers to use their design ~~and/or tool~~as a test pattern for the DRIE process.

b: Estimate effect on industry. Check one of the following:

X **1: Major effect on entire industry or on multiple important industry sectors**
- identify the relevant sectors: MEMS

☐ **2: Major effect on an industry sector**
- identify the relevant sector: _____

☐ **3: Major effect on a few companies**
- identify the relevant companies: _____

☐ **4: Slight effect or effect not determinable**

c: Estimate technical difficulty of the activity. Check one of the following:

☐ **I: No Difficulty – Proven concepts and techniques exist or quick agreement is anticipated**

☐ **II: Some Difficulty – Disagreements on known requirements exist, but developing consensus is possible**

X **III: Difficult – Limited expertise and resources exist and/or achieving consensus is difficult**

☐ **IV: Extremely Difficult – Expertise and resources are scarce and/or achieving consensus is very difficult**

2. Scope:

a: Describe the technical areas to be covered or addressed by this Document development activity.

(For Subordinate Standards, list common concepts or criteria that the Subordinate Standard inherits from the Primary Standard, as well as differences from the Primary Standard.)

This standard will describe a family of test patterns useful for characterizing the etch performance of a specific tool/test chamber. The OA of these test patterns are expected to ~~include 1%, 3%, 5%, 10%, 20%, 50% and 100% to~~ cover the range from 1% to 50% to reflect the most commonly requested etch types from ~~Gyro and Accelerometers all the way to Blanket etches (where the entire wafer surface is exposed).~~various MEMS device families (gyroscope, accelerometers, microphones, etc.).

In addition, since the use of test masks alone will not be able to provide guidance on the tilt requirement of devices such as ~~Gyros~~gyroscope – one of the main drivers for DRIE in recent years – the task force will consider including test pattern elements that can be evaluated using electrical test methods.

MEMS foundries can implement this test pattern, allowing them to incorporate the results into their design guidelines, eliminating the need for customers to use their design as a test pattern for the DRIE process. In the absence of a standard test method for evaluating this pattern, this document will include a "Related Information" section to discuss metrology for this test pattern.

b: Expected result of activity

X New Standard or Safety Guideline (including replacement of an existing Standard or Safety Guideline)

☐ New Subordinate Standard to an existing Standard or to a new Primary Standard to be developed concurrently with this new Subordinate Standard

☐ New Preliminary Standard

☐ Major revision to an existing Standard or Safety Guideline

☐ Line-item revision to an existing Standard or Safety Guideline

☐ Line-item revision to two or more existing Standards or Safety Guidelines

☐ Reapproval of a Standard or Safety Guideline

☐ Removal of a Standard or Safety Guideline

☐ Withdrawal of a Standard or Safety Guideline

☐ Reinstatement of a Standard or Safety Guideline

☐ Publication of an existing Standard or Safety Guideline as an American National Standard

☐ New Auxiliary Information

☐ Modification of existing Auxiliary Information

For a new Subordinate Standard, identify the Primary Standard here: _____

For revision of existing Standard(s) or Safety Guideline(s), identify the Standard(s) or Safety Guideline(s) that are to be revised here: _____, and identify which parts of the Standard(s) or Safety Guideline(s) that are to be revised. (Check all that apply.)

☐ **Modification of an existing part of Standard(s) or Safety Guideline(s) including Appendices, Complementary Files, and Supplementary Materials**

☐ **Addition of one or more Appendices or Complementary Files to an existing Standard or Safety Guideline**

☐ **Addition of one or more Related Information sections or Various Materials to an existing Standard or Safety Guideline**

☐ **Revision or addition of one or more Subordinate Standards to an existing Primary Standard**

For Standards, identify the Standard Subtype below:

☐ Classification

☐ Practice

☐ Test Method

☐ Miscellaneous (describe:) _____

~~☐~~X Guide

~~X~~☐ Specification

☐ Terminology

3. Projected Timetable for Completion:

a: General Milestones

a. Activity Start: 12/01/2015

b. 1st Draft by: ~~07~~04/01/~~2016~~2019

c. (Optional) Informational Ballot by: _____

d. Letter Ballot by: ~~09~~05/01/~~2016~~2019

e: TC Chapter Approval By: ~~11/01/2016~~7/30/2019

4. Liaisons with other Global Technical Committees/TC Chapters/Subcommittees/TFs:

a: List Global Technical Committees, TC Chapters, Subcommittees, or Task Forces in your or other Regions/Locales that should be kept informed regarding the progress of this activity.
(Refer to SEMI Standards organization charts and global technical committee charters as needed.)
~~3DS-IC~~
3DP&I

---

b: Intercommittee Ballots (check one):

X will be issued – identify the recipient global technical committee(s): 3DP&I

☐ **will not be issued**

---

5. Safety Considerations:

The resulting Document is expected (Check one):

☐ **to be a Safety Guideline**

X NOT to be a Safety Guideline

NOTE FOR 'to be a Safety Guideline': When all safety-related information is removed from the Document, the Document is NOT technically sound and complete – Refer to § 15.1 of the *Regulations* for special procedures to be followed.
NOTE FOR 'NOT to be a Safety Guideline': When all safety-related information is removed from the Document, the Document is still technically sound and complete.

---

6. Intellectual Property Considerations:

a: For a new Standard or Safety Guideline and for any part to be modified or added in a Revision of published Standards and Safety Guidelines (Check one):

X the use of patented technology is NOT required.

☐ **patented technology is intended to be included in the proposed Standard(s) or Safety Guideline(s).**

(If the second box is checked, check one):

□ **Letter of Intent received**

□ **Letter of Intent not received**

b: For Revision, Reapproval, Reinstatement, or Withdrawal of existing Standard(s) and Safety Guideline(s) (Check one):

☐ **there is no known material patented technology necessary to use or implement the Standard(s) and Safety Guideline(s)**

☐ **there is previously known material patented technology necessary to use or implement the Standard(s) and Safety Guideline(s)**

c: The body of the Document and any Appendices, Complementary Files, Related Information sections, or Various Materials that may or may not be a part of the Document by reference (Check one):

☐ **will include reproduced copyrighted material**

X will NOT include reproduced copyrighted material

NOTE FOR 'the use of patented technology or a copyrighted item(s) is NOT required': If in the course of developing the Document, it is determined that patented technology or copyrighted item(s) must be used to comply with the Document, the provisions of *Regulations* § 16 must be followed.
NOTE FOR 'will include reproduced copyrighted material': A copyright release letter must be obtained from the copyright owner.

---

7. Comments, Special Circumstances:

8. TC Member Review (Check one):

X took place between (*put dates here:* ~~03/17/2016~~10/12/2018 **and ~~03/31/2016~~10/25/2018 **) before approval at the TC Chapter Meeting, or**

☐ took place between (*put dates here:* MM/DD/YYYY **and MM/DD/YYYY **) before approval by the GCS, or**

☐ is not required for this SNARF.

NOTE FOR 'TC Member Review': A TC Member Review is required by the *Regulations* for a period of at least two weeks before approval of a new, or a major revision of an existing, Standard or Safety Guideline. (See *Regulations* ¶ 8.2.1)

9. Approval Dates:

TC Chapter or GCS: ~~04/04/2016~~

Recorded in TC Chapter Minutes: ~~04/04/2016~~

If you do not have email capability, you may fax this form to the nearest SEMI office:

SEMI HQ: 1.408.428.9600
China: 86.21.6027.8511
Europe: 49.30.8187.8879
Japan: 81.3.3222.5757
Korea: 82.2.551.3406
Taiwan: 886.3.560.1555