

SEMI C103-1021

GUIDE FOR REPORTING PERFORMANCE PARAMETERS OF THE CHEMICAL MECHANICAL PLANARIZATION (CMP) CONDITIONING DISKS USED IN SEMICONDUCTOR MANUFACTURING

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1 Purpose

- 1.1 This Guide provides measurements and reporting of the parameters of disk aggressiveness.
- 1.2 This Guide provides measurements and reporting of the parameters of pad surface topography.
- 1.3 This Guide provides measurements and reporting of the parameters of disk surface topography and changes of the geometry of the disk features that are in contact with the pad during conditioning.
- 1.4 This Guide provides measurements and reporting of the changes of aggressiveness and surface topography during the pad conditioning.
- 1.5 This Guide provides for optimal sequence of the conditioning tests for multiple disks of different design.
- 1.6 This Guide provides test conditions during pad and disk break-in.
- 1.7 This Guide provides a reference to multiplicity of the analytical tools and approaches to measure pad aggressiveness.
- 1.8 This Guide provides a reference to multiplicity of the analytical tools and approaches to measure pad surface topography.
- 1.9 Reference to this Guide can be used in the quality documents from a disk supplier to an original device manufacturer (ODM)/integrated device manufacturer (IDM) customer, for example, in the technical data package or corresponding certificate of acceptance (CoA).
- 1.10 Reference to this Guide can be used for generating roadmaps for the development of new semiconductor technologies and materials.

2 Scope

- 2.1 This Guide provides guidance on how aggressiveness of CMP conditioning disks should be reported on quality documents, for example, CoA, including:
 - 2.1.1 Measuring groove height for grooved polymeric pads.
 - 2.1.2 Measuring heights of pillows for poromeric pads.
 - 2.1.3 Measuring pad thickness for grooved or non-grooved polymeric pads and poromeric pads.
- 2.2 This Guide provides guidance on how surface pad topography after conditioning with CMP disks should be reported on quality documents, for example, CoA.
 - 2.2.1 Definitions of pad surface topography parameters Ra, Rq, Rt, Rp, Rv, Sa, Sq, Rt, Sv, Sp, and other.
 - 2.2.2 Definitions of pad natural pores, pad surface asperities, asperities height distribution.
- 2.3 This Guide provides background information on the test conditions to measure and report disk aggressiveness/pad cut rate (PCR) and pad surface topography that need to be reported on quality documents, for example, CoA.
- 2.4 This Guide provides background information on the test sequence for the conditioning tests involving multiple disks that need to be reported on quality documents, for example, CoA.
- 2.5 This Guide provides generic description of comparative benefits of different metrologies to measure aggressiveness/PCR and pad surface topography.

2.6 This Guide underscores the need to report on the quality documents the metrology (or metrologies) used for the measurement, when not restricted by the suppliers' Intellectual Property (IP) information.

2.6.1 This Guide underscores the need to report on quality documents, for example, CoA, the conditions, at which parameters have been measured, such as degree of pad wetting.

2.6.2 This Guide underscores the need to report on quality documents, for example, CoA, the test sampling, such as, at which location of the pad the tests have been conducted, whether the whole pad or pad coupons have been used, from which location on the pad the coupon was taken, etc.

2.7 This Guide underscores the need to provide, when not restricted by the suppliers' IP, information on equipment used to run conditioning tests, and need to report the used equipment type on quality documents, for example, CoA.

2.8 This Guide provides information on conditioning process parameters, when not restricted by the suppliers' IP, and need to report the used equipment type on quality documents, for example, CoA.

2.8.1 Conditioning process parameters include the following examples: disk down force, platen rotation per minute (rpm), disk rpm, disk swing arm recipes, slurry flow rate, wafer head rpm and down force, test duration.

2.8.2 Information and disk and pad break-in processes, when applicable.

2.9 This Guide provides information on consumables used for conditioning process, and need to report the used consumables on quality documents, for example, CoA, if consumables are not IP-sensitive.

2.9.1 Consumables for conditioning include the following examples: slurry, slurry dilution, deionized water (DIW) content, pad type, disk conditioner type, wafer type and material, etc.

2.10 This Guide underscores the need to provide information on quality documents, for example, CoA, related to the disk design, such as geometry dimensions of the disk features that are relevant to disk performance.

2.11 When conditioning performance is evaluated on the wafer level, this Guide provides information on the list of the process indicators required for such evaluation and needed to be reported on quality documents, for example, CoA.

2.10.1 The list of process indicators includes, for example, wafer defectivity, removal rate (RR), non-uniformity (NU), planarity, edge exclusion, etc.

NOTICE: SEMI Standards and Safety Guidelines do not purport to address all safety issues associated with their use. It is the responsibility of the users of the Documents to establish appropriate safety and health practices, and determine the applicability of regulatory or other limitations prior to use.

3 Limitations

3.1 Due to the proprietary nature of CMP disks, this Guide will not address any specifics regarding disk manufacturing processes.

3.2 Due to the proprietary nature of CMP disks, this Guide will not address any composition of the disk substrates and coatings, or production steps to manufacture such substrates or coatings.

3.3 This Guide does not define which parameters, analytical tool and techniques, process test conditions and recipes, process parameters and process consumables, sampling technique, should be used for reporting of pad aggressiveness/PCR or pad surface topology. It only determines that these techniques, conditions, processes, and consumables should be reported on, for example, technical data package, CoAs, or other quality documents to the extent that this reporting does not violate IP policy of the supplier.

4 Referenced Standards and Documents

4.1 None.

NOTICE: Unless otherwise indicated, all documents cited shall be the latest published versions.

5 Terminology

5.1 *Abbreviations and Acronyms*

5.1.1 *CoA* — certificate of acceptance

- 5.1.2 *DIW* — deionized water
- 5.1.3 *PCR* — pad cut rate
- 5.1.4 *PSR* — pad surface roughness
- 5.1.5 *QC* — quality control
- 5.1.6 *RR* — removal rate
- 5.1.7 *RPM* — rotation per minute

5.2 Definitions

- 5.2.1 *break-in* — preliminary conditioning process to normalize pad and disk surface topology.
- 5.2.2 *pad cut rate (PCR)* — the rate with which top layer of the pad is being removed during conditioning.
- 5.2.3 *pad surface roughness (PSR)* — morphology/roughness of the pad surface after conditioning with CMP disk.
- 5.2.4 *polymeric pads* — relatively hard one or two-layered polymer-based pad with usually grooved surface.
- 5.2.5 *poromeric pad* — relatively soft two multilayered polymer-based pad with embossed surface.

6 Background to Data Reporting of CMP Disk Aggressiveness, or PCR

- 6.1 PCR measurements are based on different metrologies:
 - 6.1.1 Measuring groove height change for the grooved polymeric pads.
 - 6.1.2 Measuring pillow heights change for embossed poromeric pads.
 - 6.1.3 Measuring thickness of the pads before/after conditioning.
 - 6.1.4 Measuring the depth of an artificial hole in the pad.
 - 6.1.5 PCR measurements can be performed on the whole pad placed on the platen of a polisher.
 - 6.1.6 PCR measurement can be performed using pad coupons and desktop polishers.

7 Challenges of Reporting of Disk Aggressiveness/PCR, Pad Topography and Pad Surface Roughness (PSR) for CMP Conditioning Disks

- 7.1 Disk conditioning is conducted in the different process conditions, using different process recipes and different combination of consumables.
- 7.2 PCR is measured using different parameters, such as changes of pad thickness, groove heights, etc.
- 7.3 Selection of PCR parameter is determined by the type of the pads: polymeric, poromeric, grooved/nongrooved.
- 7.4 PSR is measured using different analytical tools, such as mechanical stylus, confocal microscopy, atomic force microscopy, white light spectrometry, etc.
- 7.5 PSR is reported using different parameters to measure changes in surface topography after conditioning, such as the sets of areal or linear parameters of surface roughness, distribution of asperities heights, etc.
- 7.6 Disk aggressiveness values and changes of surface topography tested for the whole pad and pad coupons do not always match.
- 7.7 Disk aggressiveness and changes of surface topography tested for the different areas at the whole pad, or for the coupons, taken from the different parts of the pad, do not always match.
- 7.8 When disk performance is measured on the wafer polishing level, process recipes and combination of consumables vary for different suppliers.
- 7.9 Test cost, including cost of the test consumables is a challenge.
- 7.10 Test longevity, especially, for marathon tests, is a challenge.
- 7.11 Disk to disk, and pad to pad potential property variations is a challenge.