

SEMI C104-0622

GUIDE FOR REPORTING PERFORMANCE PARAMETERS OF THE POLYMER WINDOWS FOR CHEMICAL MECHANICAL PLANARIZATION (CMP) PADS USED IN SEMICONDUCTOR MANUFACTURING

This Standard was technically approved by the Liquid Chemicals Global Technical Committee. This edition was approved for publication by the global Audits and Reviews Subcommittee on January 4, 2022. Available at www.semiviews.org and www.semi.org in June 2022.

1 Purpose

- 1.1 This Guide provides directions for measurements and reporting the parameters of chemical mechanical planarization (CMP) pad windows.
- 1.2 This Guide provides directions for reporting metrology tools used to measure parameters of the CMP pad windows.
- 1.3 This Guide provides the list of the parameters for CMP pad windows required to measure and report on quality documents.
- 1.4 Reference to this Guide can be used in the quality documents (i.e., in the technical data package or corresponding certificate of acceptance [CoA]) from a pad supplier to an original device manufacturer (ODM)/integrated device manufacturer (IDM) customer.
- 1.5 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 and what parameters of CMP pad windows should be reported on quality documents (e.g., CoA), including:
 - 2.1.1 Reporting individual wavelengths and wavelength bands for measuring windows transmission.
 - 2.1.1.1 Transmission should be reported at specific wavelengths, for example, at three specific wavelengths, such as 200, 400, 633, or 750 to 800 nm, etc.
 - 2.1.1.2 Transmission should be reported in the continuous spectra of wavelengths, or wavelength bands, such as from 200 nm to 1,000 nm or above.
 - 2.1.2 Transmission degradation should include reporting the number and intensity of the laser beam exposures.
 - 2.1.2.1 Transmission degradation should be reported at the specific wavelengths.
 - 2.1.2.2 Transmission degradation should be reported in the continuous spectra of wavelengths.
 - 2.1.2.3 Transmission degradation should be reported for a stand-alone window polymer due to interaction with chemistry used in the CMP process (changes in properties due to interactions).
 - 2.1.2.3.1 Chemistry to which polymer window was exposed to measure transmission degradation should be reported.
 - 2.1.2.3.2 Conditions of exposure of polymer window to chemistry (i.e., time and temperature of exposure), should be reported.
 - 2.1.2.4 Transmission degradation of polymer window integrated into the pad after the CMP process can be important to measure and report.
 - 2.1.2.4.1 Combination of consumables, such as slurry, pad, conditioning disks, used for CMP process to determine pad window degradation, can be reported when not restricted by the suppliers' Intellectual Property (IP)
 - 2.1.2.4.2 CMP process conditions, such as platen, wafer, and disk RPMs, wafer and disk down force (DF), arm swing oscillation parameters, can be reported when not restricted by the suppliers' IP.

- 2.1.3 Window thickness should be reported.
- 2.1.4 Window recess with regard to pad surface in contact with wafers should be reported.
- 2.1.5 Pad thickness for grooved or non-grooved polymeric pads and poromeric pads should be reported.
- 2.1.6 Window hardness for a stand-alone window should be reported.
- 2.1.7 Window scratch resistance can be reported.
- 2.1.8 Comparison of window cut rate (WCR) to compare with pad cut rate (PCR) can be reported.
- 2.1.9 Window surface roughness for either a new stand-alone window, or non-used integrated pad should be reported.
- 2.1.10 Window shape should be reported.
- 2.1.11 Window dimensions should be reported.
- 2.1.12 Placement locations of the window on the pad should be reported.
- 2.1.12.1 If subpad is used, manufacturing process procedures should ensure that subpad is not covering up pad window.
- 2.1.13 This Guide underscores the need to provide information on metrology tools used to determine transmission degradation, when not restricted by supplier IP.
- 2.1.14 This Guide underscores the need to report on quality documents (i.e., CoA), the conditions at which the parameters have been measured (e.g., the degree of window wetting after polish, the location at which the window recess was measured, and the location at which the pad thickness was measured).
- 2.1.15 This Guide underscores the need to report on quality documents, the locations at which pad thickness, and window recess (i.e., edge or center) were measured.

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 pad windows, this Guide does not address:
 - 3.1.1 Specifics regarding CMP pad windows manufacturing processes.
 - 3.1.2 Material composition to manufacture CMP pad window.
 - 3.1.3 Production steps to integrate CMP pad windows into CMP pads.
- 3.2 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 parameters of CMP pad windows. It only determines that these techniques, conditions, metrologies, processes and consumables should be reported 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 *CMP* — chemical mechanical planarization
 - 5.1.2 *CoA* — certificate of acceptance
 - 5.1.3 *DF* — down force
 - 5.1.4 *IP* — intellectual property

5.1.5 *PCR* — pad cut rate

5.1.6 *RPM* — rotations per minute

5.1.7 *RR* — removal rate

5.1.8 *WCR*— window cut rate

5.1.9 *WIWNU* — within the wafer non-uniformity

5.2 Definitions

5.2.1 *end point detection (EPD)* — a change in the signal strength of a specific measurement that occurs during the transition from one material layer to the next.

5.2.2 *pad cut rate (PCR)* — the rate with which top layer of the pad is being removed during conditioning.

5.2.3 *transmission* — optical transmission is a measure of what proportion of light is transmitted through a certain material or medium.

5.2.4 *transmission degradation* — decrease in optical transmission due to exposure of the material to certain doses of light exposure, irradiation, atmospheric and other effects.

5.2.5 *window cut rate (WCR)* — the rate with which window top layer of the window polymer is being removed during conditioning.

6 Background to Reporting Performance Parameters of the Polymer Windows for CMP Pads

6.1 Light transmission for polymer windows at multiple specific wavelengths (i.e., three specific wavelengths) should be reported in a specific range (i.e., between 200 nm to 800 nm).

6.1.1 Light transmission signal noise, if observed, should be reported.

6.2 Transmission degradation as percent decrease of transmission after repeated exposures to laser beams, or other light sources, should be reported.

6.2.1 Shelf life-dependent transmission degradation, if observed, should be reported.

6.2.2 Transmission degradation should include reporting the number and intensity of the laser beam exposures.

6.2.3 Transmission degradation should be reported in the continuous spectra of wavelengths.

6.2.4 Wavelengths at which transmission degradation is measured should be reported.

6.2.5 Exposure time, atmospheric conditions, such as humidity, temperature, etc. should be reported.

6.2.6 Transmission degradation of polymer window integrated into the pad after the CMP should be reported.

6.2.6.1 Combination of consumables, such as slurry, pad, conditioning disks, used for CMP process to determine pad window degradation, should be reported when not restricted by the suppliers' IP.

6.2.6.2 CMP process conditions used to measure transmission degradation, such as platen, wafer, and disk RPMs, wafer and disk DF, slurry flow, time of conditioning, arm swing oscillation parameters, etc., should be reported when not restricted by the suppliers' IP.

6.2.6.3 CMP equipment used to conduct planarization process, should be reported when not restricted by the suppliers' IP.

6.3 Identification of the window samples by the batch level, production run, raw material, etc., for which the above parameters are measured, should be reported when available.

6.4 Transmission and transmission degradation should be reported for both pad windows integrated into the pad, and for stand-alone windows/polymer sheets.

6.4.1 For stand-alone window, performance/transmission degradation due to interaction with slurry, cleaning and other chemistries used in CMP processes, should be reported.