

SEMI P31-0304

PRACTICE FOR CATALOG PUBLICATION FOR CHEMICAL AMPLIFIED (CA) PHOTORESIST PARAMETER

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1 Purpose

1.1 The purpose of this document is to provide a baseline for publication of chemical amplified (CA) photoresist parameters.

2 Scope

2.1 This document applies to CA photoresist used for semiconductor manufacturing.

2.2 This document is used as the guide to evaluate photoresist process parameters.

2.3 This document is not applicable for quality assurance.

NOTICE: This standard does not purport to address safety issues, if any, associated with its use. It is the responsibility of the users of this standard to establish appropriate safety and health practices and determine the applicability of regulatory or other limitations prior to use.

3 Referenced Standards

None.

4 Terminology

4.1 *Abbreviations and Acronyms*

4.1.1 *PEB* — post exposure bake

5 Description

NOTE 1: The following parameters for CA photoresist publication and test conditions should be described in the catalog.

5.1 Resist, overcoat and developer commercial name

5.2 Temperature and humidity

5.3 Environmental conditions (see Section 6)

5.4 Ammonia concentration measurement method (see Section 7)

5.5 Delay time dependency (see Section 8)

5.6 PEB temperature dependency (see Section 9)

5.7 PEB time dependency (see Section 10)

5.8 Substrate dependency (see Section 11)

5.9 Measurement Conditions

5.9.1 Resist Coating and Development

5.9.1.1 Resist baking method (contact baking or proximity baking)

5.9.1.2 Resist pre-baking temperature and time

5.9.1.3 Resist PEB temperature and time

5.9.1.4 Development time

5.9.1.5 Resist thickness

5.9.2 Exposure

5.9.2.1 Illumination conditions (NA, σ , etc.)

5.10 Equipment Name

5.10.1 Exposure equipment

5.10.2 SEM equipment

5.10.3 Ammonia concentration measurement equipment

6 Environmental Conditions

6.1 *Ammonia Concentration* — It is recommended to measure all CA photoresist parameters under the condition that the ammonia concentration is less than $10 \mu\text{g}/\text{m}^3$.

NOTE 2: CA photoresist is sensitive to the atmosphere, especially to ammonia. Acid from photoacid generator upon exposure is neutralized by the basic material in atmosphere like ammonia.

7 Ammonia Concentration Measurement Method

7.1 The ammonia concentration is measured by ion chromatography or another method which is capable to determine the ammonia concentration quantitatively less than $10 \mu\text{g}/\text{m}^3$. The measurement equipment is calibrated with a standard ammonia solution.

8 Delay Time Dependency

NOTE 3: This section defines process conditions and procedures to obtain the delay time dependency.

8.1 *Resist Coating and Pre-baking* — Resist should be coated on a substrate. Suppliers should be notified of the kind of substrate and underlying film. After pre-baking, the resist thickness should be chosen the bottom of swing curve between 0.3–0.5 μm . Thickness could be changed in accordance with exposure wavelength. The actual thickness should be notified.

8.2 *Delay Time* — Delay time between resist coating and exposure, exposure and PEB, and PEB and development used for obtaining delay time dependency parameters are defined in Table 1.

Table 1 Delay Time Condition

<i>Resist coating to exposure delay time</i>						
0 min.			1 hour		6 hour	24 hour
NOTE: Normal sequential procedure without intentional delay between exposure and PEB as well as PEB and development.						
<i>Exposure to PEB delay time</i>						
0 min.	10 min.	30 min.	1 hour	2 hour		24 hour
NOTE: Normal sequential procedure without intentional delay between resist coating and exposure as well as PEB and development.						
<i>PEB to development delay time</i>						
0 min.	10 min.	30 min.	1 hour			24 hour
NOTE: Normal sequential procedure without intentional delay between resist coating and exposure time as well as exposure and PEB.						

NOTE: Zero minutes (0 min.) is defined as normal sequential procedure without intentional delay.

8.3 Measurement

8.3.1 After each time delay, fabricated 0.10 μm and 0.15 μm line and space patterns should be measured by SEM.

8.3.2 Record the measured pattern size.

8.3.3 Make the plotting of pattern size vs. delay time.

9 PEB Temperature Dependency

NOTE 4: This section defines process conditions and procedures to obtain the PEB temperature dependency.

9.1 *Resist Coating and Pre-baking* — Resist should be coated on a substrate. Suppliers should be notified of the kind of substrate and underlying film. After pre-baking, the resist thickness should be chose the bottom of the swing curve between 0.3–0.5 μm . Thickness could be changed in accordance with exposure wavelength. The actual thickness should be notified.

9.2 Measurement

9.2.1 Ten points of temperature should be selected within $\pm 20^\circ\text{C}$ from the optimized PEB temperature.

9.2.2 Record the measured pattern size.

9.2.3 Make the plotting of pattern width vs. PEB temperature. At least 6 to 8 points of pattern width should be plotted within the deviation of $\pm 10\%$ from the optimized line width of 0.10 μm and 0.15 μm line and space patterns.

9.2.4 The cross section of resist patterns is observed and compared each other with standard sample. One should be selected from the optimized condition and the other one should be selected from the sample deviated around 10% from standard one.