

SEMI D78-0224

TEST METHOD OF WATER VAPOR BARRIER PROPERTY FOR PLASTIC FILMS WITH HIGH GAS BARRIER FOR ELECTRONIC DEVICES

This Standard was technically approved by the Flat Panel Display – Materials & Components Global Technical Committee. This edition was approved for publication by the global Audits and Reviews Subcommittee on December 14, 2023. Available at www.semiviews.org and www.semi.org in February 2024; originally published October 2018.

NOTICE: Paragraphs entitled ‘NOTE:’ are not an official part of this Standard or Safety Guideline and are not intended to modify or supersede the official Standard or Safety Guideline. These have been supplied by the global technical committee to enhance the usage of the Standard or Safety Guideline.

1 Purpose

1.1 High gas barrier property is required to plastic films for electronic devices such as flexible displays. The purpose of this Standard is regulation of defects test method for plastics films with high gas barrier.

2 Scope

2.1 Determination of water vapor barrier property of plastic films with high gas barrier used for electronics devices such as flexible displays.

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 Test methods are adapted for plastic films with high gas barrier which water vapor transmission rate is lower than 10^{-3} g/m² day.

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 Definitions

5.1.1 *defect* — pinholes, cracks, and scratches of the surface of plastic films with high gas barrier.

6 Summary of Test Method

6.1 *Preparation of Test Samples* — Prepare plastic films with high gas barrier, which the size is larger than 20 mm × 20 mm square.

6.2 *Fabrication of Test Samples* — Deposit Ca and Al in this order on plastic films with high gas barrier and fix these films on glass substrate with a mixture of beeswax and paraffin.

6.3 *Measurement of Test Samples* — Store test samples in a temperature and humidity chamber after initial status is confirmed. After specified time, observe and measure Ca corrosion state.

6.4 *Evaluation of Test Result* — Count the number of Ca corrosions and calculate Ca corrosion area ratio.

6.5 *Test Report* — Report the evaluation results.

7 Apparatus

7.1 *Vacuum Vapor Deposition System* — Vacuum vapor deposition system is equipped with at least two vapor sources and two metal masks for patterning deposition.

7.2 *Pot* — Pot is used to mix melted beeswax and paraffin.

7.3 *Oven or Hot Plate* — Oven or hot plate is used for melting beeswax and paraffin.

7.4 *Temperature and Humidity Chamber* — Temperature fluctuation is less than $\pm 1^{\circ}\text{C}$, humidity fluctuation is less than $\pm 5\%\text{RH}$.

7.5 *Observation System* — Microscope is equipped with length measuring system and camera system with image processor.

8 Reagents and Materials

8.1 *Ca Pellet* — For vapor deposition.

8.2 *Al Pellet* — For vapor deposition.

8.3 *Beeswax* — Melting point 60°C to 62°C .

8.4 *Paraffin* — Melting point 60°C to 62°C .

8.5 *Glass Plate* — To fix test samples.

9 Test Specimens

9.1 *Test Samples* — Plastic films with high gas barrier.

9.1.1 *Size* — Larger than $20\text{ mm} \times 20\text{ mm}$ square.

9.1.2 *Pre-Treatment* — No contamination on the surface, which contact with Ca. Dehydrate the test sample.

NOTE 1: Especially when the gas barrier layer consists of organic-inorganic stacked layers, sufficient dehydration treatment is required.

9.2 *Fabrication of Measurement Sample*

9.2.1 *Ca Layer Deposition* — Form a patterned Ca layer on the test sample using a metal mask with a pattern size of $12\text{ mm} \times 12\text{ mm}$ square or larger but not larger than the test sample. Target thickness for the Ca layer is $100\text{ nm} \pm 10\text{ nm}$.

9.2.2 *Al Layer Deposition* — Form an Al layer on the Ca layer using a metal mask. This Al layer shall completely cover the Ca deposition area. Target thickness for the Al layer is 1000 nm or thicker.

9.2.3 *Fabrication of the Protection Material* — Mixture of beeswax and paraffin 1:1 by weight is melted in the pot.

9.2.4 *Fabrication of the Measurement Sample* — Fix the test sample with melted beeswax and paraffin on a glass plate.

NOTE 2: Place the Ca/Al layer deposited test sample on a specific shaped frame made of silicone rubber with the Al layer facing up. Pour and fill the melted beeswax and paraffin mixture into the frame that the test sample is placed. Wait until the melted beeswax and paraffin is cooled and solid. After that, remove the frame and prepare the measurement sample.