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**NATIONAL STANDARD OF THE
PEOPLE'S REPUBLIC OF CHINA**

GB/T 47239.5-2026

**Semiconductor devices - Flexible and stretchable
semiconductor devices - Part 5: Test method for thermal
characteristics of flexible materials**

(English Translation)

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Foreword

This document complies with the provisions of GB/T 1.1-2020 "Standardization Work Guidelines Part 1: Structure and Drafting Rules of Standardization Documents".

Drafting.

This document is Part 5 of GB/T 47239 "Semiconductor Devices - Flexible and Stretchable Semiconductor Devices". GB/T 47239 has been issued.

The following parts were laid out.

- Part 1: Bending test method for conductive thin films on flexible substrates;
- Part 2: Evaluation methods for electron mobility, subthreshold swing, and threshold voltage of flexible devices;
- Part 3: Performance evaluation of thin-film transistors on flexible substrates in a raised state;
- Part 4: Fatigue evaluation of flexible conductive films on flexible semiconductor device substrates;
- Part 5: Test methods for thermal properties of flexible materials;
- Part 6: Thin-film resistance testing methods for flexible conductive films;
- Part 7: Test methods for barrier properties of flexible organic semiconductor packaging

films;

---Part 8: Test methods for the ductility, flexibility and stability of flexible resistive memory;

---Part 9: Performance testing method for one-transistor-one-resistor (1T1R) resistor memory cell.

This document is equivalent to IEC 62951-5:2019 "Semiconductor devices - Flexible and stretchable semiconductor devices - Part 5: Thermal design of flexible materials".

Feature testing methods.

---The URLs for the ISO and IEC terminology databases have been removed from the terminology and definitions section.

Please note that some content in this document may involve patents. The issuing organization of this document assumes no responsibility for identifying patents.

This document was proposed by the Ministry of Industry and Information Technology of the People's Republic of China.

This document is under the jurisdiction of the National Semiconductor Device Standardization Technical Committee (SAC/TC78).

Introduction

Flexible and stretchable semiconductor devices possess characteristics such as stretchability, bendability, deformability, light weight, and variable shape, and can be used in robotic skin, etc.

Applications include wearable devices, optoelectronic products, and energy storage products. This is driven by advancements in semiconductor device technology and the development of flexible, stretchable semiconductor devices.

The widespread application of semiconductors has placed higher demands on product quality and reliability. GB/T 47239 "Flexible and Stretchable Semiconductor Devices" the "Semiconductor Devices" standard is a fundamental standard for testing and experimenting with flexible and stretchable semiconductor devices, and is essential for evaluating the performance of these devices.

It plays an important role in energy, stability, and reliability. It is planned to consist of 9 parts.

---Part 1: Bending Test Methods for Conductive Thin Films on Flexible Substrates. The purpose is to specify the bending test methods for conductive thin films on flexible semiconductor substrates.

---Part 2: Evaluation Methods for Electron Mobility, Subthreshold Swing, and Threshold Voltage of Flexible Devices. The aim is to define the evaluation methods for flexible devices under bending conditions.

Evaluation methods for electrical parameters such as mobility, subthreshold swing, and threshold voltage of flexible thin-film transistor devices.

---Part 3: Performance Evaluation of Thin Film Transistors on Flexible Substrates in a Raised State. The aim is to define the performance of flexible substrates in a raised state.

Evaluation methods for thin-film transistor characteristics.

---Part 4: Fatigue Evaluation of Flexible Conductive Thin Films on Flexible Semiconductor Device Substrates. The aim is to specify the requirements for flexible semiconductor device substrates.

A fatigue evaluation method for flexible conductive films on a board.

---Part 5: Test methods for thermal properties of flexible materials. The purpose is to specify the test methods for the thermal properties of flexible materials.

---Part 6: Methods for testing the sheet resistance of flexible conductive films. The purpose is to specify the methods for testing the sheet resistance of flexible conductive films.
method.

---Part 7: Test Methods for Barrier Properties of Flexible Organic Semiconductor Packaging Films. The purpose is to specify the barrier properties of flexible organic semiconductor packaging films.

Test methods for membrane barrier properties.

---Part 8: Test methods for the ductility, flexibility, and stability of flexible resistive memory. The purpose is to specify the requirements for flexible resistive memory.

Terminology and definitions, as well as testing equipment and procedures for ductility, flexibility and stability.

---Part 9: Performance Test Methods for One-Transistor-One-Resistor (1T1R) Resistive Storage Cells. The purpose is to specify the performance test methods for one-transistor-one-resistor storage cells.

Terminology and definitions for resistive (1T1R) memory cells, as well as test apparatus and test stimuli for the performance parameters of resistive memory cells.

and testing process.

GB/T 47239 (all parts) corresponds to IEC 62951 (all parts), unifying the testing of flexible and stretchable semiconductor devices.

And testing methods to support the development of the flexible semiconductor device industry.

Flexible and stretchable semiconductor devices

1 Scope

This document describes the testing methods for the thermal properties of flexible materials, including relevant terms, definitions, and symbols used for evaluating the thermal properties of flexible materials.

The method is a non-contact optical thermometry method, mainly based on the relationship between the optical reflectivity of a material and its temperature.

This document applies to flexible substrates and flexible thin-film semiconductor materials that can be bent or stretched.

2 Normative references

This document has no normative references.

3 Terms and Definitions

The following terms and definitions apply to this document.

reflectance

The reflectance of a material surface to light flux at a specific wavelength and temperature.

Note: Reflectivity can also be defined as the ratio of reflected luminous flux to incident luminous flux or the ratio of reflected luminous flux to radiation.

[Source. GB/T 2900.65-2023, 845-04-58, with modifications] 3.2 Thermoreflectance the relationship between the emissivity of a material surface to light and its surface temperature.

Note: There is no relationship between thermal reflectivity and the reflectivity of heat.

local temperature

Temperature of a local area in a spatially distributed device or system.

average temperature

The average temperature of the target area on the substrate surface at a given time. See formula (1).

$T_{avg} =$

$\frac{1}{n} \sum_{i=1}^n$

$T_{loc(i)}$ (1)

In the formula.

n --- The total number of temperature test points;