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

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**Micro-electromechanical systems (MEMS) technology - Wafer
curvature and cantilever beam deflection test methods for
determining residual stresses of MEMS films**

微机电系统（MEMS）技术 MEMS膜残余应力的晶圆曲率和悬臂梁挠度试验方法
(English Translation)

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Foreword

This document is in accordance with the provisions of GB/T 1.1-2020 "Guidelines for standardization work Part 1: Structure and drafting rules for standardization documents" Drafting.

This document is equivalent to IEC 62047-16:2015 "Semiconductor devices - Microelectromechanical devices - Part 16: MEMS membrane residual stress Test Methods Wafer Curvature and Cantilever Beam Deflection Test Methods.

The following minimal editorial changes were made to this document.

--- In order to coordinate with the existing standards, the name of the standard is changed to "Micro-electromechanical System (MEMS) Technology MEMS Film Residual Stress Wafer Curvature and cantilever beam deflection test method";

--- For ease of understanding, "Note 2" of 3.2 is added, the definition of "entity" that does not appear in the text is deleted, and the definition of "deflection" is added.

definition;

--- Added the description of the characters σ_{max} , σ_{hs} , κ in formula (1);

---Corrected the error of missing subscripts for E and ν in the original text;

--- Added the description of the characters L and δ in formula (3);

--- Added "Note" in Figure 1 and Figure 2.

1 Scope

This document describes a method for measuring residual stress in MEMS membranes with a thickness range of 0.01 μm to 10 μm , including the wafer curvature method and Cantilever beam deflection method.

This document is applicable to films deposited on substrates with known mechanical properties such as Young's modulus and Poisson's ratio.

2 Normative references

The contents of the following documents constitute the essential conditions of this document through normative references in this document.

For referenced documents without a date, only the version corresponding to that date applies to this document; for referenced documents without a date, the latest version (including all amendments) applies to this document.

IEC 62047-21 Semiconductor devices Micro-electromechanical devices Part 21: Test method for Poisson's ratio of thin film MEMS materials (Semi-filmMEMSmaterials)

3 Terms and definitions

The following terms and definitions apply to this document.

residual stress σ_{res} Stress that remains after external loads (force, heat) are removed.

Curvature

The amount by which a geometric object (wafer) deviates from a plane.

NOTE 1 For a circle, $\kappa = 1/R$, where R is the radius.

Note 2: In a double-layer structure consisting of a membrane and a substrate, if the center of curvature is on the same side as the membrane, the curvature is positive; if the center of curvature is on the opposite side of the membrane, the curvature is negative.

Deflection

The displacement of the free end of the beam in the normal plane of the axis at that point when it is deformed.

Note: In a double-layer structure consisting of a membrane and a substrate, if the beam is bent in the same direction as the membrane, the deflection is positive; if the beam is bent in the opposite direction to the membrane, the deflection is negative.

4.1 Overview

When residual stress exists in the deposited film of the MEMS structure, it will cause the double-layer structure composed of the film and the substrate to bend together.