



Standard Test Method for Residual Strain Measurements of Thin, Reflecting Films Using an Optical Interferometer¹

This standard is issued under the fixed designation E2245; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reapproval.

^{ε1} NOTE—Reference (1) was editorially revised in September 2013.

1. Scope

1.1 This test method covers a procedure for measuring the compressive residual strain in thin films. It applies only to films, such as found in microelectromechanical systems (MEMS) materials, which can be imaged using an optical interferometer, also called an interferometric microscope. Measurements from fixed-fixed beams that are touching the underlying layer are not accepted.

1.2 This test method uses a non-contact optical interferometric microscope with the capability of obtaining topographical 3-D data sets. It is performed in the laboratory.

1.3 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 ASTM Standards:²

E2244 Test Method for In-Plane Length Measurements of Thin, Reflecting Films Using an Optical Interferometer

E2246 Test Method for Strain Gradient Measurements of Thin, Reflecting Films Using an Optical Interferometer

E2444 Terminology Relating to Measurements Taken on Thin, Reflecting Films

E2530 Practice for Calibrating the Z-Magnification of an Atomic Force Microscope at Subnanometer Displacement Levels Using Si(111) Monatomic Steps (Withdrawn 2015)³

2.2 SEMI Standard:⁴

MS2 Test Method for Step Height Measurements of Thin Films

3. Terminology

3.1 Definitions:

3.1.1 The following terms can be found in Terminology E2444.

3.1.2 *2-D data trace, n*—a two-dimensional group of points that is extracted from a topographical 3-D data set and that is parallel to the xz - or yz -plane of the interferometric microscope.

3.1.3 *3-D data set, n*—a three-dimensional group of points with a topographical z -value for each (x, y) pixel location within the interferometric microscope's field of view.

3.1.4 *anchor, n*—in a surface-micromachining process, the portion of the test structure where a structural layer is intentionally attached to its underlying layer.

3.1.5 *anchor lip, n*—in a surface-micromachining process, the freestanding extension of the structural layer of interest around the edges of the anchor to its underlying layer.

3.1.5.1 *Discussion*—In some processes, the width of the anchor lip may be zero.

3.1.6 *bulk micromachining, adj*—a MEMS fabrication process where the substrate is removed at specified locations.

3.1.7 *cantilever, n*—a test structure that consists of a freestanding beam that is fixed at one end.

3.1.8 *fixed-fixed beam, n*—a test structure that consists of a freestanding beam that is fixed at both ends.

3.1.9 *in-plane length (or deflection) measurement, n*—the experimental determination of the straight-line distance between two transitional edges in a MEMS device.

3.1.9.1 *Discussion*—This length (or deflection) measurement is made parallel to the underlying layer (or the xy -plane of the interferometric microscope).

¹ This test method is under the jurisdiction of ASTM Committee E08 on Fatigue and Fracture and is the direct responsibility of Subcommittee E08.05 on Cyclic Deformation and Fatigue Crack Formation.

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² For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

³ The last approved version of this historical standard is referenced on www.astm.org.

⁴ For referenced Semiconductor Equipment and Materials International (SEMI) standards, visit the SEMI website, www.semi.org.