



Designation: E 2444 – 05

## Terminology Relating to Measurements Taken on Thin, Reflecting Films<sup>1</sup>

This standard is issued under the fixed designation E 2444; 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 ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

### 1. Scope

1.1 This standard consists of terms and definitions pertaining to measurements taken on thin, reflecting films, such as found in microelectromechanical systems (MEMS) materials. In particular, the terms are related to the standards in Section 2, which were generated by Committee E08 on Fatigue and Fracture. Terminology E 1823 Relating to Fatigue and Fracture Testing is applicable to this standard.

1.2 The terms are listed in alphabetical order.

### 2. Referenced Documents

#### 2.1 ASTM Standards:<sup>2</sup>

E 1823 Terminology Relating to Fatigue and Fracture Testing

E 2244 Test Method for In-Plane Length Measurements of Thin, Reflecting Films Using an Optical Interferometer

E 2245 Test Method for Residual Strain Measurements of Thin, Reflecting Films Using an Optical Interferometer

E 2246 Test Method for Strain Gradient Measurements of Thin, Reflecting Films Using an Optical Interferometer

### 3. Terminology

#### 3.1 Terms and Their Definitions:

**2-D data trace**—a two-dimensional data trace that is extracted from a topographical 3-D data set and that is parallel to the  $xz$ - or  $yz$ -plane of the interferometer.

DISCUSSION—The height of the sample is measured along the  $z$ -axis of the interferometer. The interferometer's  $x$ -axis (as shown in Figs. 1-3) is typically aligned parallel or perpendicular to the transitional edges to be measured. **E 2244**

**3-D data set**—a three-dimensional data set with a topographical  $z$ -data value for each ( $x$ ,  $y$ ) pixel location within the interferometer's field of view. **E 2244**

**anchor**—in a surface-micromachining process, the portion of the test structure where a structural layer is intentionally

attached to its underlying layer (see Figs. 1-3). **E 2244**

**anchor lip**—in a surface-micromachining process, the free-standing extension of the structural layer of interest around the edges of the anchor to its underlying layer (see Fig. 2). In some processes, the width of the anchor lip may be zero. **E 2244**

**bulk micromachining**—a MEMS fabrication process where the substrate is removed at specified locations. **E 2244**

**cantilever**—a test structure that consists of a freestanding beam that is fixed at one end (such as shown in Fig. 3). **E 2246**

**fixed-fixed beam**—a test structure that consists of a freestanding beam that is fixed at both ends (such as shown in Figs. 1 and 2). **E 2245**

**in-plane length (or deflection) measurement,  $L$  (or  $D$ ) [L]**—a length (or deflection) measurement made parallel to the underlying layer (or the  $xy$ -plane). **E 2244**

**interferometer**—a non-contact optical instrument used to obtain topographical 3-D data sets. **E 2244**

**MEMS**—microelectromechanical systems. **E 2244**

**microelectromechanical systems, MEMS**—in general, this term is used to describe micron-scale structures, sensors, and actuators and/or the technologies used for their manufacture (such as, silicon process technologies). **E 2244**

**out-of-plane measurements [L]**—measurements taken on structures that are curved out-of-plane in the  $z$ -direction (that is, perpendicular to the underlying layer). **E 2444**

**residual strain,  $\epsilon_r$** —in a surface-micromachining process, the strain present in the structural layer of interest after fabrication yet before the sacrificial layer is removed. In a bulk-micromachining process, the strain present in the suspended layer after fabrication yet before the substrate is removed at specified locations. **E 2245**

**sacrificial layer**—a layer that is intentionally deposited (or added) then removed, in whole or in part, during the micromachining process, to allow freestanding microstructures. **E 2244**

**stiction**—adhesion between the portion of a structural layer that is intended to be freestanding and its underlying layer. **E 2246**

**(residual) strain gradient,  $s_g$  [ $L^{-1}$ ]**—a through-thickness linear gradient (of residual strain) in the structural layer of interest before it is released that is used to represent the

<sup>1</sup> 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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<sup>2</sup> 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.