

SEMI MS3-0915

TERMINOLOGY FOR MEMS TECHNOLOGY

This Standard was technically approved by the MEMS/NEMS Global Technical Committee. This edition was approved for publication by the global Audits and Reviews Subcommittee on May 19, 2015. Available at www.semiviews.org and www.semi.org in September 2015; originally published as SEMI PR11-1105; previously published March 2007.

1 Purpose

1.1 Microelectromechanical Systems (MEMS) technology, while related in many ways to integrated circuit and device technology, has many differences as well. Terminology for MEMS, in particular, often differs significantly. To promote common understanding and clear communication among suppliers, customers, and others in the field, these terms should be defined.

1.2 This Terminology Document covers definitions of terms used in MEMS technology, especially in those areas of greatest interest to the SEMI community.

2 Scope

2.1 This Terminology covers terms describing generic attributes of MEMS devices and of materials and processes used in their manufacture. These attributes include electrical, structural, chemical, dimensional and other characteristics and nomenclature.

2.2 This Terminology is applicable for use in connection with research, development, process control, inspection, and procurement of MEMS materials and structures.

2.3 Almost all of the terms for which definitions are listed are nouns. Unless the part of speech is given for any particular term, it can be assumed that the term is a noun.

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 Terms defined adequately for MEMS usage in standard English-language dictionaries are not further defined here.

4 Referenced Standards and Documents

4.1 *SEMI Standards and Safety Guidelines*

SEMI MS5 — Test Method for Wafer Bond Strength Measurements Using Micro-Chevron Test Structures

4.2 *ASTM Standard*¹

ASTM E2444 — Terminology Relating to Measurements Taken on Thin, Reflecting Films²

NOTICE: Unless otherwise indicated, all documents cited shall be the latest published versions.

5 Abbreviations and Acronyms

5.1 *CMOS* — complementary metal oxide semiconductor

5.2 *CMP* — chemical mechanical planarization

5.3 *DRIE* — deep reactive ion-etch

5.4 *DUT* — device under test

¹ ASTM International, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959, USA; Telephone: 610.832.9585, Fax: 610.832.9555, <http://www.astm.org>

² Referenced definitions reprinted, with permission, from the Annual Book of ASTM Standards.

- 5.5 *EFIC* — electrofluidic integrated circuit
- 5.6 *FFT* — fast Fourier transform
- 5.7 *FOV* — field of view
- 5.8 *HARM* — high aspect ratio micromachining
- 5.9 *IAS* — inner surface alignment system
- 5.10 *IC* — integrated circuit
- 5.11 *LED* — light emitting diode
- 5.12 *LIGA* — lithographie, galvanoförmung und abförmung (Note: The German words for lithography, electroforming and molding.)
- 5.13 *MEMS* — microelectromechanical systems (see also *MST*).
- 5.14 *MOEMS* — micro-opto-electromechanical systems
- 5.15 *MST* — micro systems technology (see also *MEMS*). (Note: *MST* is a more common term than *MEMS* in Europe. Also known as ‘micromachines’ in Japan.)
- 5.16 *OAS* — outer surface alignment system
- 5.17 *PZT* — piezoelectric transducer

6 Definitions

- 6.1 *2-D data trace* — a two-dimensional group of points that is parallel to the *xz*- or *yz*-plane of the instrument.
 - 6.1.1 *Discussion* — For many instruments, the 2-D data trace is extracted from a 3-D data set.
- 6.2 *3-D data set* — a three-dimensional group of points with a topographical *z*-value for each (*x*, *y*) pixel location within the field of view of the instrument.
- 6.3 *actuator* — a device that performs mechanical work using electric energy, chemical energy, or other energy forms.
- 6.4 *anchor* — the portion of the test structure, in a surface-micromachining process, where a structural layer is intentionally attached to its underlying layer.
- 6.5 *anisotropic etching* — process exploiting the occurrence of differing etch rates in different crystallographic directions in a material.
- 6.6 *aspect ratio* — the ratio of the long dimension to one of the other dimension(s) (width or length) of a two- or three-dimensional structure.
- 6.7 *backside patterning* — generation of images on the backside of wafers using masks.
- 6.8 *bimetallic actuator* — a device that creates motion by exploiting the (usually thermal) properties of structures having two metallic layers (bimetal).
- 6.9 *bioMEMS* — *MEMS* for biological, biomedical or certain analytical applications.
- 6.10 *bond strength* — the material's resistance against crack propagation measured in units of energy per unit area.
- 6.11 *bonding aligner* — a tool that positions patterned substrates prior their being bonded.
- 6.12 *bonding, anodic* — a technique for bonding a glass substrate, which contains movable ions, to an electrically conducting substrate (e.g., silicon, metal).
- 6.13 *bonding, diffusion* — joining materials by heating them below their melting points while pressing them together to achieve solid state adherence by interdiffusion of their atoms.
- 6.14 *bonding, eutectic* — joining of mutually soluble (usually metallic) materials by an alloy of both having a melting point lower than that of either material.

- 6.15 *bonding, glass frit* — a process of adhering two or more wafers using a low melting point glass powder (frit) as an intermediate layer.
- 6.16 *bonding, low temperature* — wafer bonding process by surface activation, during which the temperature stays below 150°C.
- 6.17 *bonding, thermal compression* — a process using heat and pressure to cause plastic flow of materials for bonding.
- 6.18 *bonding, thermosonic* — a process using pressure, elevated temperature, and high frequency vibrational energy for wafer bonding (see *bonding, ultrasonic*).
- 6.19 *bonding, ultrasonic* — a process using pressure and high frequency vibrational energy for wafer bonding (see *bonding, thermosonic*).
- 6.20 *bonding, wafer* — a process that creates permanent face-to-face attachment between two substrates (see *wafer*).
- 6.21 *bosch process* — a proprietary silicon micromachining technique using alternating DRIE and deposition to create deep structures with vertical walls, such as high aspect ratio holes or posts.
- 6.22 *breaking strength* — the stress acting in a solid material at the moment when it is broken by external force.
- 6.23 *bulk micromachining* — a MEMS fabrication process that removes the substrate at specified locations.
- 6.24 *cantilever* — a MEMS test structure that consists of a freestanding beam that is fixed at one end.
- 6.25 *cell handling* — manipulation or treatment of biological cells.
- 6.26 *chemical machining* — a process that forms structures of desired geometry, dimensions, and surface conditions by concentrating or limiting chemical dissolution in specific locations on a material.
- 6.27 *comb drive* — an electrostatically actuated MEMS device, incorporating interdigitated fingers, used in inertial sensors and RF resonators.
- 6.28 *critical crack length* — the depth of penetration of the narrow split between bonded wafers that occurs at the maximum applied load, after which, an unstable fracture process results and the propagation of this narrow split accelerates.
- 6.29 *critical wafer bond toughness* — the material parameter used to characterize the bond strength between two materials at their interface expressed in terms of energy per unit area.
- 6.30 *dead volume* — sections or volumes in a flow path where a fluid can fill but is not easily available or returned into the flow stream. The fluid in these areas becomes stagnant and purging of the fluid is very inefficient. Not the same as hold-up volume.
- 6.31 *deep reactive ion-etch (DRIE)* — a dry-etch process used to create high-aspect-ratio structures in silicon.
- 6.32 *device under test (DUT)* — the device undergoing evaluation.
- 6.33 *digital light processor* — an array of movable micro-mirrors that control independently the direction and intensity of individual pixels of light in an image.
- 6.34 *digital micromirror device* — see *digital light processor*.
- 6.35 *displacement sensor* — a device that detects physical motion.
- 6.36 *dynamic seals* — seals that operate with moving surfaces.
- 6.37 *electrofluidic integrated circuit (EFIC)* — the integration of semiconductor electronics and microfluidics on a common substrate.
- 6.38 *electroforming* — a process of replicating shapes by electro-deposition of metals using a resin or metal mold.
- 6.39 *electrostatic force* — force proportional to the electric field between electrodes or electric charges.
- 6.40 *electromagnetic actuator* — a device that applies a current flowing through a coil of conducting material to produce a physical movement.