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Standard Guide for Performing Sputter Crater Depth Measurements[1]

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1. Scope

1.1 This guide covers the preferred procedure for acquiring and post-processing of sputter crater depth measurements. This guide is limited to stylus-type surface profilometers equipped with a stage, stylus, associated scan and sensing electronics, video system for sample and scan alignment, and computerized system.

1.2 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

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]

E673 Terminology Relating to Surface Analysis (Withdrawn 2012)[3]

3. Terminology

3.1 *Definitions:*

3.1.1 Terms used in surface analysis are defined in Terminology E673.

4. Significance and Use

4.1 Sputter crater depth measurements are performed in order to determine a sputter rate (depth/time) for each matrix sputtered during a sputter depth profile or similar in-depth type analyses. From sputter rate values, a linear depth scale can be calculated and displayed for the sputter depth profile.

4.2 Data obtained from surface profilometry are useful in monitoring instrumental parameters (for example, raster size, shape, and any irregularities in topography of the sputtered crater) used for depth profiles.

5. General Procedure

5.1 Upon completing a sputter depth profile, mark the crater for future identification (one can mark the exterior corner(s) of a crater with features, for example, lines, holes, etc., produced using an unrastered ion beam). Note the crater orientation with respect to the other sample features

5.2 Place the sample on the profilometer stage surface. If the sample has an area of less than 1 cm^2, mount the sample onto another larger flat surface to prevent sample movement when profilometry is performed. The system should be reasonably leveled; for details on instrumental adjustments, see manufacturer's operating manual(s). Keep the environment as dust-free as possible and dust-off the sample surface with a clean air/gas jet before performing the measurement.

5.3 Pre-select surface profilometer operational settings; computerized models are commonly used. Most surface profilometers commonly permit selection of the following parameters:

5.3.1 Stylus type (for example, diamond stylus).

5.3.2 Stylus radius (for example, 5 µm; various stylus radii are available depending upon desired resolution of measurement, and to a certain degree the strength of the stylus tip for varying hardness of materials).

5.3.3 Stylus force (that is, force exerted on the analytical sample during operation, for example, 15 mg; this is an important variable when profiling a sample with high hardness levels; damage to the stylus may occur, and hence damage to the instrumentation or errors in profilometry measurements, or both, may result), similarly, excessive force can damage soft samples such as polymers or photoresists and result in erroneous measurements.

5.3.4 Scan speed (for example, 50 µm/s; this value is dependent upon permissible noise levels, accuracy, etc., and is typically determined experimentally).

5.3.5 Scan length (one typically uses twice the crater size to allow for scanning over the level areas about the sputtered crater.

[1] This guide is under the jurisdiction of ASTM Committee E42 on Surface Analysis and is the direct responsibility of Subcommittee E42.06 on SIMS.

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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.