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Standard Guide for Reporting of Ion Beam Parameters Used in Surface Analysis[1]

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1. Scope

1.1 This guide covers the information needed to characterize ion beams used in surface analysis.

1.2 This guide does not cover all information required to perform a sputter depth profile (see referenced documents), specify any properties of the specimen except its surface normal, and discuss the rationale for choosing a particular set of ion beam parameters **(1)**.[2] This guide does assume that the ion flux has a unique direction, that is, is an ion beam, rather than a wide spectrum of velocity vectors more typical of a plasma.

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:*

E 673 Terminology Relating to Surface Analysis[3]

E 684 Practice for Approximate Determination of Current Density of Large-Diameter Ion Beams for Sputter Depth Profiling of Solid Surfaces[3]

E 996 Practice for Reporting Data in Auger Electron Spectroscopy and X-Ray Photoelectron Spectroscopy[3]

E 1127 Guide for Depth Profiling in Auger Electron Spectroscopy[3]

E 1162 Practice for Reporting Sputter Depth Profile Data in Secondary Ion Mass Spectrometery (SIMS)[3]

3. Terminology

3.1 *Definitions:*

3.1.1 For definitions of terms used in this guide, see Terminology E 673.

4. Summary of Guide

4.1 This guide describes ion beam parameters to be reported so that experiments can be reproduced and understood.

5. Significance and Use

5.1 Ion beams are utilized in surface analysis in two ways. First, they can generate signals from the specimen, for example, in SIMS and ISS. Second, they can remove material from the specimen surface while a surface analytical technique determines the composition of the freshly exposed surface. This process is called sputter depth profiling. Ideally, this guide requires reporting all characteristics of the ion beam that can possibly affect the results so that the measurement can be reproduced.

6. Information to be Reported

6.1 *Ion Gun Instrumentation*—Specify the manufacturer, type, and model of the ion gun (as well as of the analytical spectrometer). Report the base pressure of the spectrometer vacuum chamber, the pressure in the vacuum chamber during the ion gun operation, and any information on the gas pressure within the ionization chamber of the ion gun. If a mass filter is used, note its characteristics.

6.2 *Recommended Ion Beam Parameters*— The following ion beam parameters may vary in both space and time. Report such variations. For example the ion beam may be pulsed as is sometimes done in static SIMS. If so, report the pulse duration and repetition rate (Hz). The spatial uniformity of the ion beam can be monitored by measuring the ion current with a Faraday cup whose aperture diameter is much smaller in size than the ion beam diameter **(2)**. If a Faraday cup is used whose aperture is larger than the ion beam diameter, temporal variations of the ion beam current can be observed.

6.2.1 *Composition*—Report species present and their charge states, for example, Ar^{+} and Ar^{++}, as well as their relative concentrations. If a neutral trap is used, report its use and its location.

6.2.2 *Kinetic Energy* (keV)—Report the kinetic energy of the ion beam as it impacts on the specimen surface. It is this energy that controls many ion/solid effects **(1)** rather than the energy of the ion beam as it leaves the gun. These two energies will differ if the specimen is electrically biased.

[1] This guide is under the jurisdiction of ASTM Committee E-42 on Surface Analysis and is the direct responsibility of Subcommittee E42.08 on Ion Beam Sputtering.

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[2] The boldface numbers given in parentheses refer to a list of references at the end of this guide.

[3] *Annual Book of ASTM Standards*, Vol 03.06.