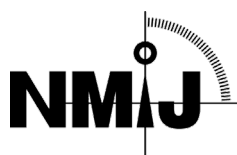


National Institute of Advanced Industrial Science and Technology

## National Metrology Institute of Japan



## Reference Material Certificate

NMIJ CRM 5202-a  
No. +++SiO<sub>2</sub>/Si Multilayer Film

This certified reference material (CRM) is produced in accordance with the NMIJ's management system and is in compliance with ISO 17034 and ISO/IEC 17025. This CRM is intended for use in controlling the precision of analysis or adjusting the measurement condition during the depth-profile analysis by ion-sputtering with Auger electron spectroscopy, X-ray photoelectron spectroscopy and Secondary ion mass spectrometry.

**Certified Values**

This CRM has five-layer-structure and the certified values for the thickness from the second to fifth layer are given in the table below. The thicknesses of the first SiO<sub>2</sub> layer is information because the surface contaminants are expected to increase over time. The uncertainty of the certified value is the expanded uncertainty obtained by multiplying the combined standard uncertainty by a coverage factor (*k*) of 2, and it is the half-width of an interval estimated to have a level of confidence of approximately 95 %.

Substance	CAS No.	Certified value Thickness (nm)	Expanded uncertainty Thickness (nm)
First layer (SiO <sub>2</sub> )	7631-86-9	-	-
Second layer (Si)	7440-21-3	20.0	0.6
Third layer (SiO <sub>2</sub> )	7631-86-9	20.5	0.8
Fourth layer (Si)	7440-21-3	19.9	0.5
Fifth layer (SiO <sub>2</sub> )	7631-86-9	20.4	0.6

**Analysis**

The certified values of this CRM were determined by X-ray reflectometry.

**Metrological Traceability**

The certified values of this CRM were determined based on X-ray wavelength from the CODATA recommended values and the calibrated angle. The angle was calibrated by an autocollimator and a polygon mirror (12 faces). Those values are traceable to the International System of Units (SI).

**Expiration of Certification**

This certificate is valid for one year from the date of shipment, provided that the CRM is stored in accordance with the instructions given in this certificate.

**Description of the Material**

This CRM is in the form of a piece 13 mm square packaged in a plastic container.

**Instructions for Storage**

This CRM should be stored in a dry and clean environment at a temperature between 5 °C and 35 °C.

**Instructions for Use**

The certified values of this CRM represent the thickness of the entire sample area. Several points on the CRM should therefore

be measured, and the mean value used in case the measurement area is significantly smaller than the size of the CRM.

#### Precautions for Handling

Clean gloves and tweezers should be used in handling to prevent contamination. Refer to the safety data sheet (SDS) on this CRM before use.

#### Preparation

The five layers with SiO<sub>2</sub> and Si of the CRM were grown using the RF magnetron sputtering method on a 3-inch Si substrate, and then the chips of the CRM were cut from the wafer.

#### Technical Information

The thickness of the first SiO<sub>2</sub> layer was 21 nm at the time of measurement for the certification

#### NMIJ Analysts

The technical manager for the CRM is KOJIMA I. The production manager and the analyst are AZUMAYA Y.

#### Information

If substantive technical changes occur that affect the certification before the expiration of this certificate, NMIJ will notify the registered customer. Customer registration on the NMIJ Website (given below) will facilitate notification. Technical reports regarding this CRM can be obtained from the contact details given below.

#### Reproduction of Certificate

In reproducing this certificate, it should be clearly indicated that the document is a copy.

April 1, 2020

ISHIMURA Kazuhiko  
President

National Institute of Advanced Industrial Science and Technology

If you have any questions about this CRM, please contact:  
National Institute of Advanced Industrial Science and Technology,  
National Metrology Institute of Japan,  
Center for Quality Management of Metrology, Reference Materials Office,  
1-1-1 Umezono, Tsukuba, Ibaraki 305-8563, Japan  
Phone: +81-29-861-4059; Fax: +81-29-861-4009, <https://unit.aist.go.jp/nmij/english/refmate/>

#### Revision record

April 1, 2015: "Metrology Management Center" was renamed to "Center for Quality Management of Metrology."

November 20, 2017: The description in "Expiration of Certification" was changed to "one year from the date of shipment."