

National Institute of Advanced Industrial Science and Technology

National Metrology Institute of Japan



Reference Material Certificate

NMIJ CRM 5208-a
No. +++)

Au/Ni/Cu Multi-layer Metal 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 analyses and adjusting the measurement conditions in the area of the density and film thickness analysis by an X-ray Fluorescence (XRF) spectrometer.

Certified Values

This CRM is composed of Au/Ni/Cu multiple metal layers on a Cr-coated quartz glass substrate. The certified values for the area density and the film thickness of each metal layer are given in the tables below. The uncertainty of each certified value is the half-width of the expanded uncertainty interval calculated using a coverage factor (k) of 2, which gives a level of confidence of approximately 95 %.

	CAS No.	Certified value, Area density of metal layer ($\mu\text{g}/\text{mm}^2$)	Expanded uncertainty, Area density ($\mu\text{g}/\text{mm}^2$)
Au/Ni/Cu multi-layer metal film	Au:7440-57-5	1.84	0.05
	Ni:7440-02-0	8.69	0.17
	Cu:7440-50-8	8.80	0.14

	CAS No.	Certified value, Film thickness of metal layer (nm)	Expanded uncertainty, Film thickness (nm)
Au/Ni/Cu multi-layer metal film	Au:7440-57-5	95	5
	Ni:7440-02-0	996	19
	Cu:7440-50-8	1020	28

Analysis

The certified value for the film thickness of each layer was determined by the scanning electron microscopy (SEM). The interface between the layers was defined as a position, where contrast gradient in the direction of thickness became a maximum or minimum in a backscattering electron image. According to this definition, the distances between the interfaces were measured and they were determined as the thickness of the metal layers. The certified value for the area density was determined by the inductively coupled plasma optical emission spectrometry (ICP-OES), the ICP mass spectrometry (ICP-MS), the isotope dilution ICP-MS (ID ICP-MS) and the area measurement. The homogeneity of the area density was determined by the XRF with analytical diameter of 3 mm. The combined standard uncertainties were estimated by the combining standard uncertainties derived from the measurements, the analyses, and the homogeneity of the samples.

Metrological Traceability

The certified values for the thickness are determined by a SEM instrument, whose magnification is calibrated with an NPL traceable CRM (Geller MicroAnalytical Laboratory, MRS-6). The certified value for the area density are determined based on Japan Calibration Service System (JCSS) Ni and Cr standard solutions, the NIST Au standard solution and the JCSS standard scale (Mitutoyo, HL1-50). The certified value of this CRM, therefore, is traceable to the International System of Units (SI).

Expiration of Certification

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

Sample Form

This CRM is in the form of a rectangular solid of 21 mm x 21 mm x 2 mm, packaged in a plastic container. The metal multiple layers were deposited on the one side of a substrate, and this CRM is kept in a container with the side with the metal layers facing down.

Homogeneity

The homogeneity was determined by analyzing the variance of six samples for the area density and that of two samples for the film thickness. These samples were systematically taken out of the total of 20 pieces of this CRM by giving consideration to their positional symmetry in the deposition process.

Instructions for Storage

The CRM should be stored in the nitrogen gas atmosphere at a temperature between 5 °C and 35 °C.

Instructions for Use

The certified values of the area density of this CRM were determined by the XRF with an analytical diameter of 3 mm. If a measurement area is smaller than 3 mm in diameter, therefore, take measurements at several points on the CRM and use their mean value.

Precautions for Handling

In order to avoid surface contamination of the CRM, appropriate tools such as clean gloves and tweezers should be used in handling. Refer to the safety data sheet (SDS) on this material before use.

Preparation

The Au/Ni/Cu metal multilayer film of the CRM was deposited by the RF magnetron sputtering on a 21 mm x 21 mm quartz glass substrate. This deposition process was performed by NTT Advanced Technology Corporation.

NMIJ Analysts

The technical manager for the CRM is KUROKAWA A. The production manager is TERAUCHI S. The analysts are TERAUCHI S., KUMAGAI K., TAKATSUKA T., INAGAKI K., ARIGA T. and ITO M.

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/>

Sample