

National Institute of Advanced Industrial Science and Technology

National Metrology Institute of Japan



Reference Material Certificate

NMIJ CRM 5207-a

No. +++

Tungsten Dot-array



This certified reference material (CRM) was produced in accordance with the NMIJ's management system and in compliance with ISO GUIDE 34:2009 and ISO/IEC 17025:2005. This CRM is intended for use in the magnification calibration of instruments, and examination of instrument conditions through image sharpness measurement in scanning electron microscopy (SEM).

Certified Values

This CRM has three orthogonal tungsten dot-arrays in different sizes fabricated on a silicon substrate. The dot pitches of these dot-arrays (Dot-array A, B and C) are certified respectively, and the certified values are given in the table below. The uncertainty of the certified values 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 %.

	CAS No.	Certified value, Dot pitch x (nm)	Expanded uncertainty Dot pitch x (nm)	Certified value, Dot pitch y (nm)	Expanded uncertainty Dot pitch y (nm)
Tungsten Dot-array Dot-array A	Si:7440-21-3 W:7440-33-7	119.0	1.5	119.0	1.5
Tungsten Dot-array Dot-array B		199.1	2.4	199.1	2.4
Tungsten Dot-array Dot-array C		597.7	7.3	597.7	7.3

Analysis

The certified values of each dot-array were determined by SEM. The dot pitch was defined as the average distance between two neighboring dots in a secondary electron image taken at 15 kV of primary beam condition. According to this definition, the dot pitch values were obtained via image analysis, in which 6600 dot intervals were evaluated.

Metrological Traceability

The certified values of each dot-array were determined by using a SEM instrument calibrated with a CRM for magnification calibration (Geller MicroAnalytical Laboratory, MRS-6), which has traceability to the International System of Units (SI) via a metrological atomic force microscope in the National Physical Laboratory in UK. Therefore, the certified values are traceable to SI.

Expiration of Certification

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

Description of the material

This CRM is in the form of a rectangular chip with the dimensions 7 mm width, 7 mm length, and 0.7 mm thickness. The

CRM has three dot-arrays at the center on one side of double-side mirror surface substrate, and stored in a plastic container dot-array side up. The three-arrays are placed as shown in Figure 1(a); the dot-array on the top left is Dot-array A, the top right Dot-array B and the bottom left Dot-array C. The x- and y-axes are taken along the direction shown in Figure 1(a). Note that the pattern on the bottom right is only used for fabrication process. Figure 1 (b)-(d) show the typical SEM image of each dot-array.

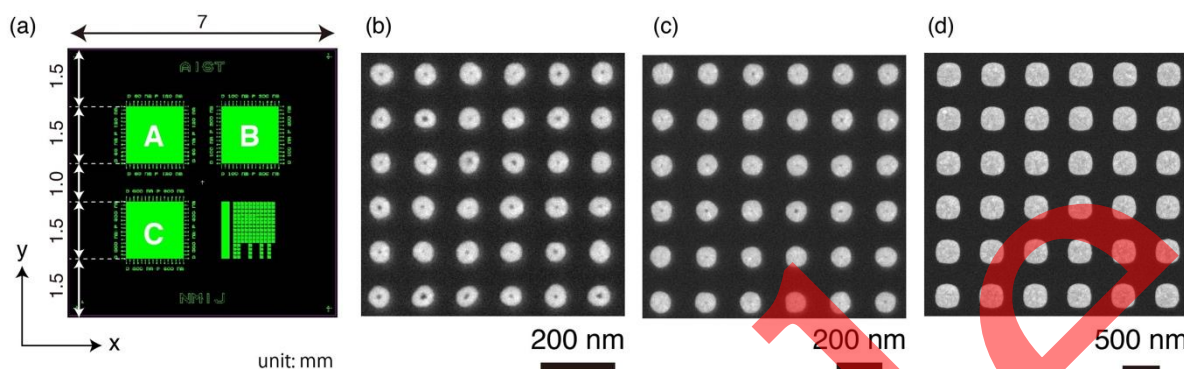


Figure 1 Chip pattern of the CRM (a). Typical SEM image of dot-arrays A (b), B (c) and C (d). Accelerating voltage was 15 kV.

Instructions for Storage

This CRM should be kept at a temperature between 5 °C and 35 °C in a dry nitrogen atmosphere in which the relative humidity is kept below 10 %.

Instructions for Use

This CRM may have few dots with shape anomalies in the dot-arrays (Figure 2). These dots should be kept out of the field of view of a micrograph for the magnification calibration or image sharpness evaluation with this CRM. Clean area of the CRM should be chosen for SEM observations that shows no effect of carbon contamination caused by electron beam irradiation. In the magnification calibration of a scanning electron microscope with this CRM, it is recommended that the actual number of dot intervals to be measured should be about 10.

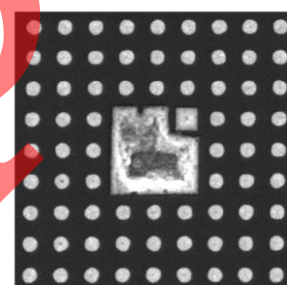


Figure 2 Shape anomalies in the dot-array

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

Tungsten dot-array was fabricated on a 300-mm silicon wafer by semiconductor fabrication technologies in the super clean room facility in TIA central office, National Institute of Advanced Industrial Science and Technology, then individually packed in National Metrology Institute of Japan.

NMIJ Analysts

The technical manager is KUROKAWA A. for this CRM. The production manager and the analyst is KUMAGAI K.

Information

If substantive technical changes occur that affect the certification before the expiration of this certificate, NMIJ will notify the registered customers. 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.

Date of Shipment: Xxxxx xx, 20xx

5207a00-180314-210930

April 1, 2020

ISHIMURA Kazuhiko

President

National Institute of Advanced Industrial Science and Technology

If you have any questions about this CRM, please contact:
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