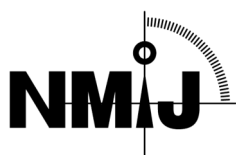


National Institute of Advanced Industrial Science and Technology  
National Metrology Institute of Japan



## Reference Material Certificate

NMIJ CRM 5810-a  
No. +++



## Titanium Nitride Film for Thermal Diffusivity Measurement

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 the calibration and validation of instruments for thermal diffusivity measurements based upon a pulsed light heating thermoreflectance method.

**Certified Value**

The certified value of this CRM is given in the table below. The uncertainty of the certified value is the relative expanded uncertainty obtained by multiplying the combined relative standard uncertainty by a coverage factor ( $k$ ) of 2, and it is the half-width of an interval of confidence estimated to have a level of confidence of approximately 95 %.

Substance	Certified value Thermal diffusivity (m <sup>2</sup> /s)	Relative expanded uncertainty (%)
Titanium Nitride Film	$3.43 \times 10^{-6}$	7.9

**Analysis**

The certified value of this CRM was determined from the thickness and the heat diffusion time in the thickness direction of the titanium nitride film. The film thickness was evaluated by the stylus-type surface roughness measurement instrument calibrated by the step height standard. The heat diffusion time was evaluated by the pulsed light heating thermoreflectance method which was originally developed by NMIJ. Specifically, the heat diffusion time was measured at multiple points within a radius of 0.5 mm from the center of the CRM at room temperature of  $22.5 \text{ }^\circ\text{C} \pm 0.5 \text{ }^\circ\text{C}$ . It should be noted that the thermal diffusivity in the in-plane direction was not evaluated.

**Metrological Traceability**

The certified value was determined based on the function generator and the step height standard as a primary method of measurement. The certified value, therefore, is traceable to the International System of Units (SI).

**Expiration of Certification**

This certificate is valid from the date of shipment to 31 March, 2026, provided that this CRM is stored in accordance with the instructions given in this certificate.

**Description of the material**

This CRM is a reddish brown titanium nitride film formed on a quartz glass plate (10 mm × 10 mm × 0.525 mm). At the center of the film, an etched pattern with a width of 0.1 mm and a length of 1.0 mm was fabricated. The average film thickness determined from randomly-sampled 12 specimens was 543.8 nm, and its standard deviation was 3.4 nm. This CRM is packed in a polypropylene case, which is sealed in a plastic bag with a desiccant and a deoxidant.

**Homogeneity**

In the evaluation of homogeneity of this CRM, significant inhomogeneity of about 1.7 % was observed among specimens. The

Date of Shipment: Xxxxx xx, 20xx

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uncertainty derived from homogeneity has been incorporated in the relative expanded uncertainty of the certified value.

#### **Instructions for Storage**

This CRM should be stored at temperature of 5 °C to 35 °C in a clean place.

#### **Instructions for Use**

Care should be taken to avoid measuring the linear pattern etched at the center. To protect this CRM from contamination, gloves or tweezers should be used for handling.

#### **Precautions for Handling**

The CRM is composed of titanium nitride and quartz glass. Refer to the safety data sheet (SDS) on this CRM before use.

#### **Preparation**

Titanium nitride film was deposited on a quartz glass wafer by means of the reactive dc magnetron sputtering method. The deposited film was diced to fabricate specimens. The thin film on the outer edge of the specimen was removed by chemical etching. At the center of the specimen, a pattern of 0.1 mm x 1.0 mm was formed by lithography and chemical etching.

#### **Technical Information**

The film thickness should be measured by using the linear step pattern with a width of 0.1 mm and a length of 1.0 mm at the center in accordance with ISO5436-1:2000.

#### **NMIJ Analysts**

The technical manager for this CRM is AKOSHIMA M., the production manager is YAGI T., and the analyst is YAGI T.

#### **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.

February 25, 2021

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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National Metrology Institute of Japan,  
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