

National Institute of Advanced Industrial Science and Technology

National Metrology Institute of Japan



## Reference Material Report

NMIJ RM 1301-a

No. +++



## Titanium Nitride Thin Film (Heat diffusion time across the thickness)

This reference material (RM) was produced in accordance with the NMIJ's management system and in compliance with ISO GUIDE 34:2000 and ISO/IEC 17025:2005. This RM is intended for use in the calibration and the validation of instruments for thermal diffusivity measurements.

**Indicative Value**

The indicative value for heat diffusion time in thickness direction of titanium nitride thin film is given in the table below. The uncertainty of the indicative 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 %.

Heat diffusion time (s)	Expanded uncertainty (s)	Relative expanded uncertainty (%)
$139.7 \times 10^{-9}$	$6.9 \times 10^{-9}$	4.9

**Analysis**

The measured value was evaluated at 298 K in atmospheric condition by the pulsed light heating thermoreflectance method originally developed by NMIJ.

**Metrological Traceability**

Heat diffusion time was determined based on the calibrated function generator and the calibrated oscilloscope as a primary method of measurement, and are traceable to the International System of Units (SI).

**Sample Form**

The outward form of the RM is dimension of  $100 \text{ mm}^2$  and thickness of 0.525 mm as shown in Figure 1. The gray filled area in Figure 1 represents titanium nitride thin film with a nominal thickness of 680 nm deposited on a quartz glass substrate by means of reactive magnetron sputtering method. Note that the thickness of the film was not certified. There is a line shape pattern with a width of 0.1 mm and a length of 1 mm, at the center of the specimen, which is utilized for measuring thickness of the specimen. There are slight amount of particles or spots on the film due to the deposition process.

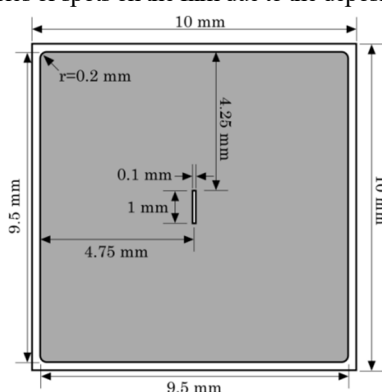


Figure 1. The outward form of the reference material.

### Homogeneity

The homogeneity of this RM was determined by analyzing 10 specimens randomly sampled from 64 specimens. The homogeneity of each specimen is reflected in the uncertainty of the indicative value.

### Instructions for Storage

This RM should be kept at  $23\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$  and a relative humidity of 50 % or less.

### Instructions for Use

For laboratory use only. Use the RM at room temperature. Wear gloves or use tweezers during handling to protect the RM against contamination.

### Precautions for Handling

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

### Preparation Method

Titanium nitride thin film was deposited on synthesized quartz glass wafers by the reactive dc magnetron sputtering. After the deposition, the wafers were cut into 64 pieces of specimens. Deposited films were chemically etched using a lithography technique in order to remove the outer edge of the film and to make a line pattern at the center of the specimen.

### NMIJ Analysts

The technical manager of this RM is N. Yamada. The production manager and analyst is T. Yagi.

### Technical Information

Customer registration on the NMIJ Website (given below) will facilitate notification of any revision of the information given above. Technical reports regarding this RM can be obtained from the contact details given below.

### Reproduction of report

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

April 1, 2015

Ryoji Chubachi  
President

National Institute of Advanced Industrial Science and Technology

If you have any questions about this RM, 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://www.nmij.jp/english/service/C/>

#### Revision history

April 1, 2015	“Metrology Management Center” was renamed to “Center for Quality Management of Metrology.”
---------------	--