

## Electric characteristics of aluminum nitride produced by atmospheric pressure plasma

大気圧プラズマで作製した窒化アルミの電気特性

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Aluminum nitride (AlN) films were prepared onto tungsten by atmospheric pressure plasma and magnetron sputtering at the substrate temperature of 200 °C, 400°C, 550°C. The volume resistivity of the thin films was investigated at the temperature of up to 550°C.

### 1. Introduction

An electromagnetic acoustic transducer (EMAT), with the non-destructive inspection technique using ultrasonic waves, will be used for in-service inspection of fast breeder reactors. In order to apply in-service, it is necessary to work at the temperature of about 550 °C. In these circumstances, we suggest a new EMAT driven by a pulse current method [1]. This EMAT consists of some multi-layers piled alternately with insulation and conduction materials. AlN and tungsten are suitable because of high thermal conductivity and an equivalence of thermal expansion coefficient. The purpose of this study is to clarify the electric characteristics of AlN under the high temperature.

### 2. Experiments and measurements

#### 2.1 Experiment procedure

The experimental setup for depositing AlN films is shown in Fig. 1. Evacuation was done at the base pressure of  $1 \times 10^{-6}$  Torr. The chamber was filled with the mixture of argon (Ar) and nitrogen (N<sub>2</sub>) gases up to a working pressure at  $3.5 \times 10^{-3}$  Torr. The substrate was heated up to each temperature (200 °C, 400°C, 550°C) by a resistive heater. A disk of pure aluminum (99.99 % in purity) was used as a sputtering target. The sputtering power supplied to the magnetron sputtering device was 200 W. The thin film was kept to grow for 3 hours.

#### 2.2 Volume resistivity technique

Volume resistivity was measured in an electrical furnace using the guarded ring electrode in accordance with JISK6911. The measuring circuit is shown in Fig.2. The geometry of the electrodes restricts the measurement path to an area between two concentric ring electrodes. The applied voltage was 50 V.

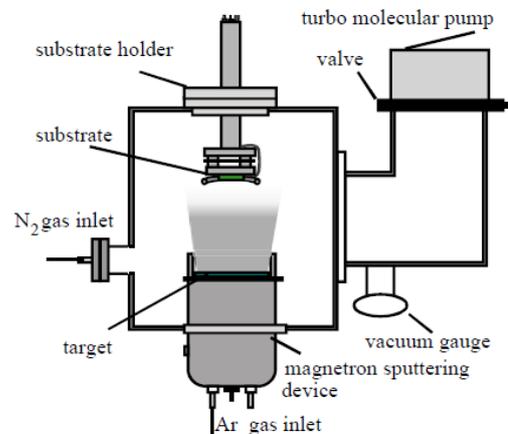


Fig.1. Experimental setup with magnetron sputtering.

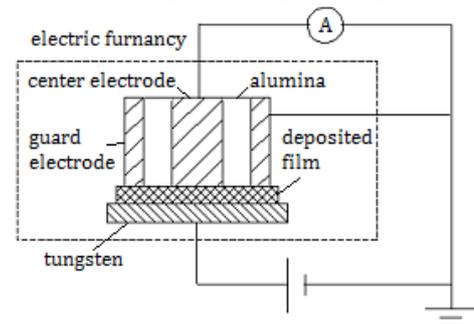


Fig.2. Volume resistivity measuring circuit.

Volume resistivity ( $\rho_v$ ) was calculated by

$$\rho_v = \frac{\pi D_1^2}{4t} R \quad (1)$$

$$R = \frac{V}{I} \quad (2)$$

where  $t$  is the thickness of the film,  $R$  is the measured resistivity in ohms.

The results for the experiment using atmospheric pressure plasma will also be reported at the presentation.

### References

- [1] Y. Ohtsuka, T. Yoshimura, Y. Ueda: IEEE. Ultrasonics Symposium. (2007) 1609-1612.