IIT MADRAS
Indian Institute of Technology Madras

Technology Transfer Office
TTO – IPM Cell

Industrial Consultancy & Sponsored Research (IC&SR)

METHOD TO REALIZE HIGHLY A-AXIS ORIENTED ALUMINIUM NITRIDE (AlN) THIN FILMS ON Mo COATED Si SUBSTRATE BY REACTIVE RF MAGNETRON SPUTTERING

IITM Technology Available for Licensing

PROBLEM STATEMENT

- Generally, the physical properties of sputter deposited Aluminum nitride (AlN) film depends on the crystallographic orientation, which is dependent on the sputtering process parameters, and by optimizing these parameters, the microstructure and growth axis (c-axis, a-axis or m-plane) of the AlN film can be controlled.
- To fabricate AlN thin film based high frequency devices, it is required to grow highly oriented AlN thin films on metal electrodes.
- However, due to lattice mismatch and difference between the coefficients of thermal expansion, it is very difficult to grow oriented AlN thin films on metal electrodes.
- Hence, based on the foregoing need. there is a requirement to address the above issues in efficient manner.

TECHNOLOGY CATEGORY/ MARKET

Technology: Aluminum Nitride (AlN) Thin Film;
Industry:, CMOS silicon technology; MEMS Device Manufacturing Industry, Electronic Industry, Energy and Infrastructure Industry;
Application: MEMS Devices, Sensors, microelectronics and power-related applications
Market: The global Aluminum Nitride market is expected to grow at a **CAGR** of 2.93% for the forecast period of 2021 to **2028.**

TECHNOLOGY

- Present invention describes **an improved a-axis AlN thin film disposed Mo coated Si substrate** for use in **fabrication of MEMS devices** in a wide range of industrial applications.
- More specifically said invention is using **reactive RF magnetron sputtering** technique.

- The featured of the claimed method comprises a few steps shown in smart chart:

1 — **First step explains about synthesizing AlN "120" and Mo thin films "120" using a vacuum deposition system having planar water cooled magnetron cathodes (50mm diameter)**

2 — **Second step explains about depositing AlN films onto the Mo coated Si substrate "110" using reactive sputtering technique by introducing a gas mixture of N_2 (reactive gas) and Ar (sputtering gas) into the chamber wherein the process condition of pressure of $5x10^{-3}$ mbar (the lowest at which stable plasma is obtained.**

- **RF power** of **250W** and **substrate temperature** of **350°C** maintained for **forming** highly **a-axis oriented AlN thin films** on highly oriented **Mo** coated **Si** substrate.

INTELLECTUAL PROPERTY

IITM IDF Ref.: **2004;**
IN Patent No. 425409 (Granted)

TRL (TECHNOLOGY READINESS LEVEL)

TRL- 3, Proof of Concept Ready Stage

RESEARCH LAB

Prof. RAMACHANDRA RAO M S
Dept. of Physics, IIT Madras
Prof. AMITAVA DAS GUPTA
Prof. DELEEP R NAIR
Dept. of Electrical Engineering, IIT Madras

CONTACT US
Dr. Dara Ajay, Head
Technology Transfer Office,
IPM Cell- IC&SR, IIT Madras

IITM TTO Website:
https://ipm.icsr.in/ipm/

Email: smipm-icsr@icsrpis.iitm.ac.in
sm-marketing@imail.iitm.ac.in
Phone: +91-44-2257 9756/ 9719

METHOD TO REALIZE HIGHLY A-AXIS ORIENTED ALUMINIUM NITRIDE (AlN) THIN FILMS ON Mo COATED Si SUBSTRATE BY REACTIVE RF MAGNETRON SPUTTERING

IITM Technology Available for Licensing

KEY FEATURES / VALUE PROPOSITION

❖ ***Technical Perspective:***

- The method as claimed that **at lower target to substrate distance** (5 to 7cm) and **higher N_2 concentration (50% to 60%), highly oriented AlN** is formed.

❖ ***Industrial Perspective:***

- Patent technology is having high demand on **fabrication of MEMS devices**, in **energy harvester** and **resonator** applications over **lead zirconate titanate (PZT)** and **ZnO** because it is compatible with standard CMOS silicon technology.
- Claimed technology is **cost effective** and able to get the **desired properties of AlN** film on Mo coated Si substrate.

IMAGES

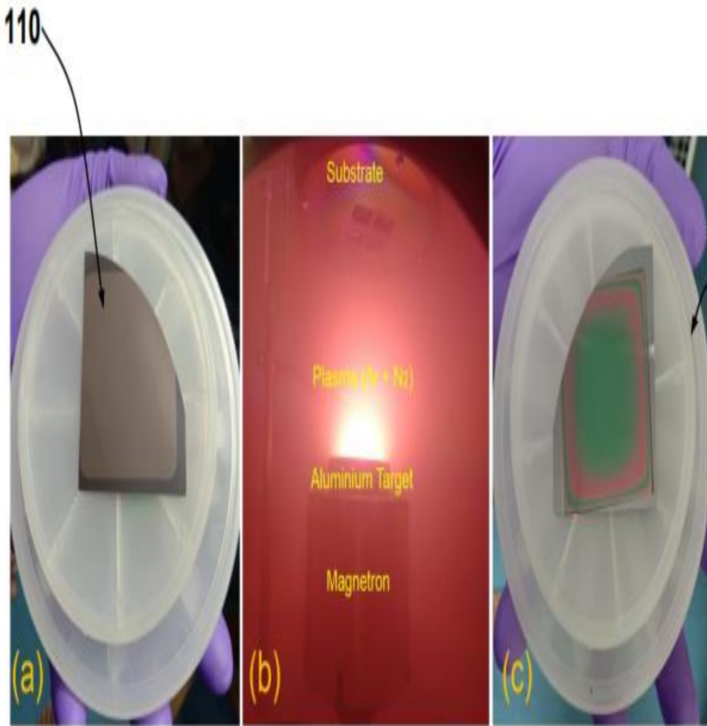

Figure 1: Illustrates a graphical representation "100" of the (110) oriented 4 Mo coated Si substrate prepared using RF sputtering technique during AlN growth and AlN thin film;

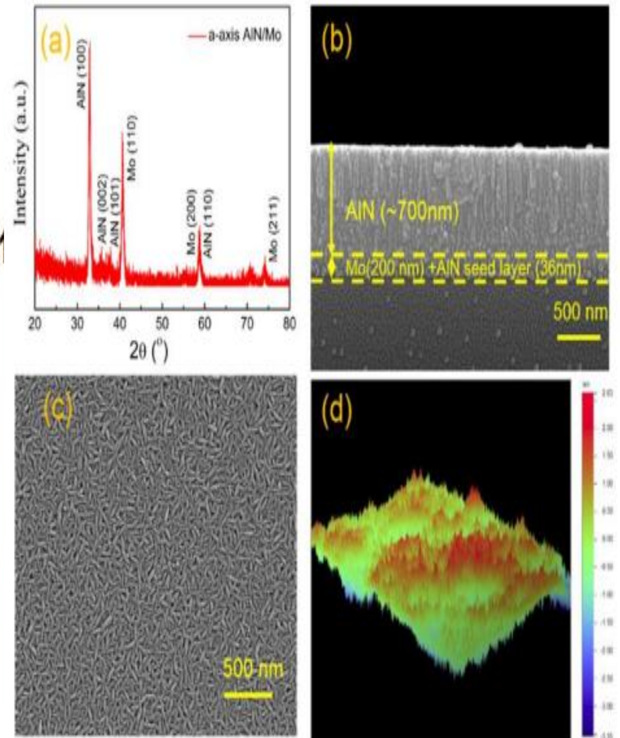

Figure 2: Illustrates graphical representation "200" of (a) XRD pattern, (b) cross-sectional-SEM image, (c) surface morphology and (d) surface roughness of the AlN thin film on Mo/AlN/Si (100) substrate,

CONTACT US
Dr. Dara Ajay, Head
Technology Transfer Office,
IPM Cell- IC&SR, IIT Madras

IITM TTO Website:
https://ipm.icsr.in/ipm/

Email: smipm-icsr@icsrpis.iitm.ac.in
sm-marketing@imail.iitm.ac.in
Phone: +91-44-2257 9756/ 9719