

I-STEM Software Request - Guide Approval Form

User Details

- **Name of Researcher:** Moolya Jyoti Poovappa
- **User Type:** Ph.D. Scholar
- **Institution Name:** Manipal Institute of Technology,
- **Institutional Contact No:** 08202925624
- **Research Topic:** Studying the Nanomechanical Properties of Aluminum Nitride Thin Films: Experimental Characterization and Finite Element Modeling

Software Request Details

- **Software Name:** COMSOL Multiphysics
- **Justification for Software Request:**

Wireless Sensor Networks (WSNs) are widely used for environmental monitoring, but their reliance on conventional batteries poses challenges in remote locations. To overcome this, integrating sensing with energy harvesting using microelectromechanical systems (MEMS) has gained interest. Among MEMS materials, piezoelectric thin films are essential for energy conversion, with aluminum nitride (AlN) emerging as a superior alternative to lead zirconate titanate (PZT) due to its CMOS compatibility, high thermal stability, and excellent piezoelectric properties.

Nanomechanical properties play a crucial role for the reliability of any device. For instance if we consider energy harvester, nanomechanical properties like Young's modulus, hardness, adhesion plays a important role in the reliability of the device. In this study, the effect of varying deposition parameters on structural, piezoelectric and nanomechanical properties on sputter-deposited AlN will be evaluated. Finite Element Modeling (FEM) tool like COMSOL will aid in establishing property correlations. By the values obtained from the experiments, the nanomechanical properties of the deposited film will be studied by modelling a nanoindenter and film setup . After completing the FEM simulations the experimental and the theoretical values will be compared. This comparison will help to validate the accuracy of the FEM predictions. Along with that an energy harvester will be simulated to understand the effect of varying nanomechanical properties on the efficiency of the device.

Guide/Supervisor Approval

I, Dr. Nagaraja K.K.,

- Confirm that the above-mentioned researcher is affiliated with our institution
- Have reviewed the software request and its relevance to the researcher's academic work
- Approve the software request for research purposes

- I approve the software request
- The software aligns with the researcher's research objectives
- The request meets the institutional research guidelines

Date: 23/08/2025

23/8/25

1. This form must be signed and scanned
2. The scanned copy must be uploaded with the software request
3. Electronic signatures are acceptable if from an official institutional email