

Executive Summary



Srinivasan Raghavan
Professor, Indian Institute of Science

1. Title of the Project: Beyond AlGaIn-GaN High Electron Mobility Transistors for power and RF electronics: **ScAlN** technology development for RF filters and nitride electronics.

2. Date of Start of the Project: October 1, 2020

3. Aims and Objectives:

Year 1 Milestone from project proposal: Reactor set up for accepting the new bubbler (its typically a 6 month shipping time for Metal Organics) and preliminary runs.

Year 2: ScAlN HEMT wafers on Si

Year 3: 100 micron gate width power transistors.

Year 4: Optimized material for power applications and 5 mm gate width power transistors.

Year 5: 500 nm gate length RF devices

4. Significant achievements (not more than 500 words to include List of patents, publications, prototype, deployment etc):

The Sc source was ordered and received, a significant achievement for international shipment of highly inflammable chemicals amidst COVID. It is currently being installed on the reactor. Once installed ScAlN material platform will be developed which will help support many device engineers who can then design and develop devices based on ScAlN. This will be analogous to the GaN effort where the material platform made available based on the work from 2009 to 2014 resulted in the sanction of a GaN fab to the IISc to a group of 6 faculty members who work on all aspects from electronics to photonics based on GaN.

Key papers published by the fellow in the last year include:

- i. [Role of Surface Processes in Growth of Monolayer MoS₂: Implications for Field-Effect Transistors](#), V Kranthi Kumar, Shashwat Rathkanthiwar, Ankit Rao, Priyadarshini Ghosh, Sukanya Dhar, Hareesh Chandrasekar, Tanushree Choudhury, SA Shivashankar, Srinivasan Raghavan, ACS Applied Nano Materials.
- ii. [Scandium-Based Ohmic Contacts to InAlN/GaN Heterostructures on Silicon](#), Vanjari Sai Charan, Sandeep Vura, R Muralidharan, Srinivasan Raghavan, Digbijoy N Nath, IEEE Electron Device Letters
- iii. [Epitaxial BaTiO₃ on Si\(100\) with In-Plane and Out-of-Plane Polarization Using a Single TiN Transition Layer](#) Sandeep Vura, Vadivukkarasi Jeyaselvan, Rabindra Biswas, Varun Raghunathan, Shankar Kumar Selvaraja, Srinivasan Raghavan, ACS Applied Electronic Materials

5. Concluding remarks

I gratefully acknowledge the financial assistance provided by the INAE through the Abdul Kalam Fellowship, which has supported the nucleation of a new material based technology area in the country. While progress was impacted by the pandemic, I believe the first ScAlN films from India by MOCVD and among the first in the world would be realized in this year.