Exploring GaN HEMTs for Cutting-Edge Wireless Technologies

Gallium nitride high electron mobility transistors (GaN HEMTs) offer a compelling combination of high-frequency operation, power handling capability, and energy efficiency making them a preferred choice for a wide range of RF and millimeter wave applications where circuit performance, size, and power efficiency are critical factors. One key application is power amplifiers for 5G and 6G wireless communications where GaN HEMTs can make a crucial difference in reducing the form factor and power consumption. However, HEMT requirements strongly differ across wireless frequency bands. For instance, the design can be orientated towards sub-20 GHz operation at higher power, or it can be for ≥28 GHz operation at relatively lower power per device. Addressing this spectrum of requirements necessitates innovations in material stack and device architectures.

Furthermore, integration of GaN HEMTs on silicon (Si) substrates is desired to enable cost-effective, scalable, and sustainable solutions for 5G and beyond wireless applications. Therefore, imec is researching on developing GaN HEMTs on Si platform which can rival their GaN-on-SiC counterparts in terms of performance and reliability.

The goal of this PhD is to develop high gain, linear, and reliable GaN HEMTs on Si substrate for 5G and 6G power amplifiers. During this PhD, you will research on:

- Electric-field engineering in the device and study its impact on HEMT power and linearity performance towards device optimization;
- HEMT design for improved power and linearity performance through channel and source-drain engineering;
- Designing and studying device gate stack and passivation for enhanced performance;
- Develop guidelines for a balanced performance-reliability oriented device scaling through device design, characterization, and physics-based modeling.

Desired background: A master's degree in electrical engineering, material science, or equivalent, with in-depth understanding of semiconductor device physics is required. Familiarity with semiconductor device fabrication and characterization is a plus. Willingness to work in a cross-functional team and collaborate with other researchers.

Type of work: Your day-to-day work will be focused around: (i) GaN device design and physical modeling. (ii) Device characterization and data analysis.

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