



RF GaN-on-Si for Beyond 5G applications

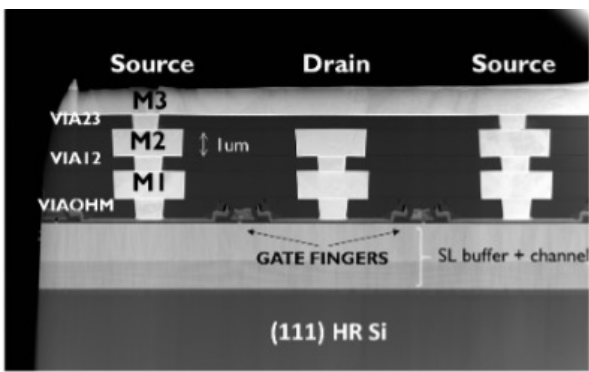
Imec's state-of-the-art RF GaN-on-Si technology targets Beyond 5G mobile handset, infrastructure and satellite Front-End Module (FEM) applications.

Over the past decade, the wireless industry has experienced a significant surge in data usage. This growth is expected to continue in the coming years, driven by emerging applications like extended reality and autonomous vehicles. To address this increasing demand for faster data rates, lower energy consumption, and reduced latency, the industry is expanding the frequency spectrum above 6GHz to leverage the larger available bandwidths. The FR3 (Frequency Range 3) spectrum, ranging from 7-24GHz, has recently gained significant interest due to its potential to balance capacity and coverage effectively.

However, higher frequencies present various challenges. Incumbent FEM process technologies addressing today's wireless applications below 6GHz can not meet the performance and/or cost requirements for Beyond 5G FR3 handset and infrastructure applications. Imec's RF GaN-on-Si technology addresses this challenge with its R&D on the following 2 platforms:

	Wireless infrastructure	Mobile handset
Device type	Depletion mode	Enhancement mode
Supply voltage (V)	≥ 28	≤ 5
Maximum power density at 13GHz (W/mm)	> 8	> 1.25
Power added efficiency at 13GHz (%)	> 50	> 50

Beyond power amplification, imec's RF GaN-on-Si technology also delivers excellent performance in RF switches and low-noise amplifiers. An attractive approach to reducing form factor and cost is to co-integrate these various components into a single Si-CMOS-compatible technology. This co-integration not only reduces cost and form factor but also improves the energy efficiency of the overall FEM.



Example of fully CMOS compatible GaN-on-Si technology with 3-level Cu BEOL (reference: B. Parvais et al, IEDM 2020)

Imec's RF GaN-on-Si technology

- CMOS-compatible 200mm RF GaN-on-Si process
- MOCVD growth of RF buffer and active layers (AlGaIn, InAlN)
- HEMT and MISHEMT devices with $L_g < 50\text{nm}$ and low resistive Ohmic contacts with $R_c < 0.15 \Omega \text{mm}$
- Advanced multi-layer Cu BEOL & integration of passives

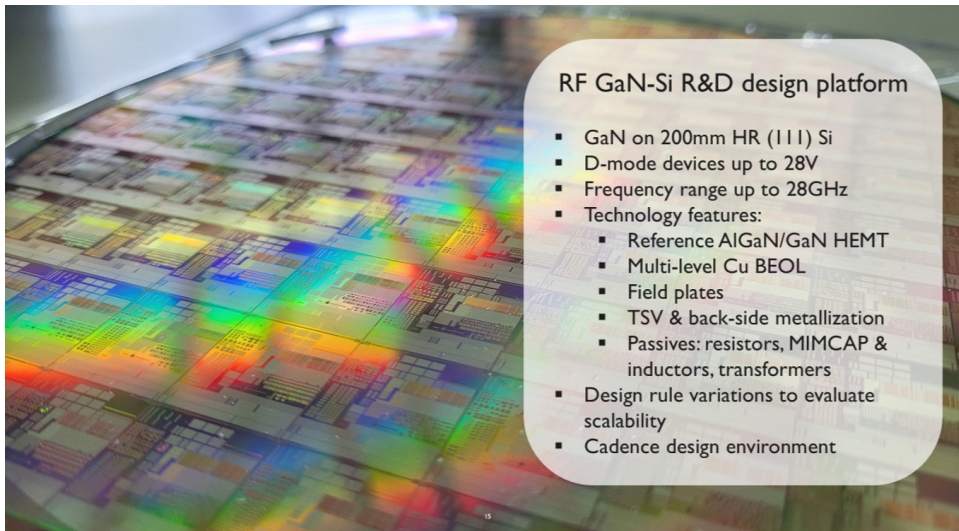
Imec RF GaN-on-Si offering

Imec's RF GaN-on-Si offering combines its long-standing expertise in semiconductor technology with its world-class knowledge of RF circuit design, systems and algorithms. It comprises:

- **RF GaN-on-Si device design and optimization** to meet the performance and reliability requirements for Beyond-5G infrastructure and handset applications
- **Modeling and advanced characterization** to help the technology pathfinding, including reliability aspects and thermal design.
- Exploration of novel device architectures and engineered substrates
- **Access to RF GaN-Si R&D design platform** for circuit exploration and the possibility to customize the technology to specific customer requirements (see below).
- **FEM system and circuit design** including System Technology Co-Optimization as well as benchmarking with incumbent technologies.
- **Demonstrators** to showcase the advantages of RF GaN-on-Si.

Work with imec

- **Program partnership:** Join the program to get early access to imec's RF GaN-Si R&D results. Co-develop the next RF technologies through precompetitive, cost- and risk-shared research.
- **Bilateral development projects:** Leverage imec's RF GaN-on-Si technology and know-how to realize a prototype or technology demonstrator for your specific requirements.



Imec's RF GaN-Si R&D design platform for wireless infrastructure applications

Go to www.imec-int.com/advancedRF for more info about the Advanced RF program, such as publications, presentations and upcoming events.

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