



THE THIN FILM POWERHOUSE

THIN FILM SOLUTIONS FOR COMPOUND SEMICONDUCTORS... AND BEYOND



A short introduction and overview

III-V Summit – Semicon EU 2025, Munich, Germany
April 25th, Maurus Tschirky, VP Strategic Marketing

1

Company introduction
- Who we are

2

Compound Semiconductors at the centre of Evatec's activities
- History and Expertise

3

Motivation for Photonic Integrated Circuits
- From piezo-electrics to electro-optics

4

Evatec's contribution to PIC
- Waveguides and Modulators

5

Outlook for Magnetron Sputter Epitaxy
- Impacting Power Devices, Optoelectronics, Connectivity (6G) and Wafer Level Optics

6

Wrap up
- Key take-aways

Our deep knowledge in **Thin Film Deposition and Material Science** makes us the company of choice to enable and drive innovations within the megatrends for **Energy Efficiency, Connectivity & Mobility, Data Processing** and **Smart Sensing**.

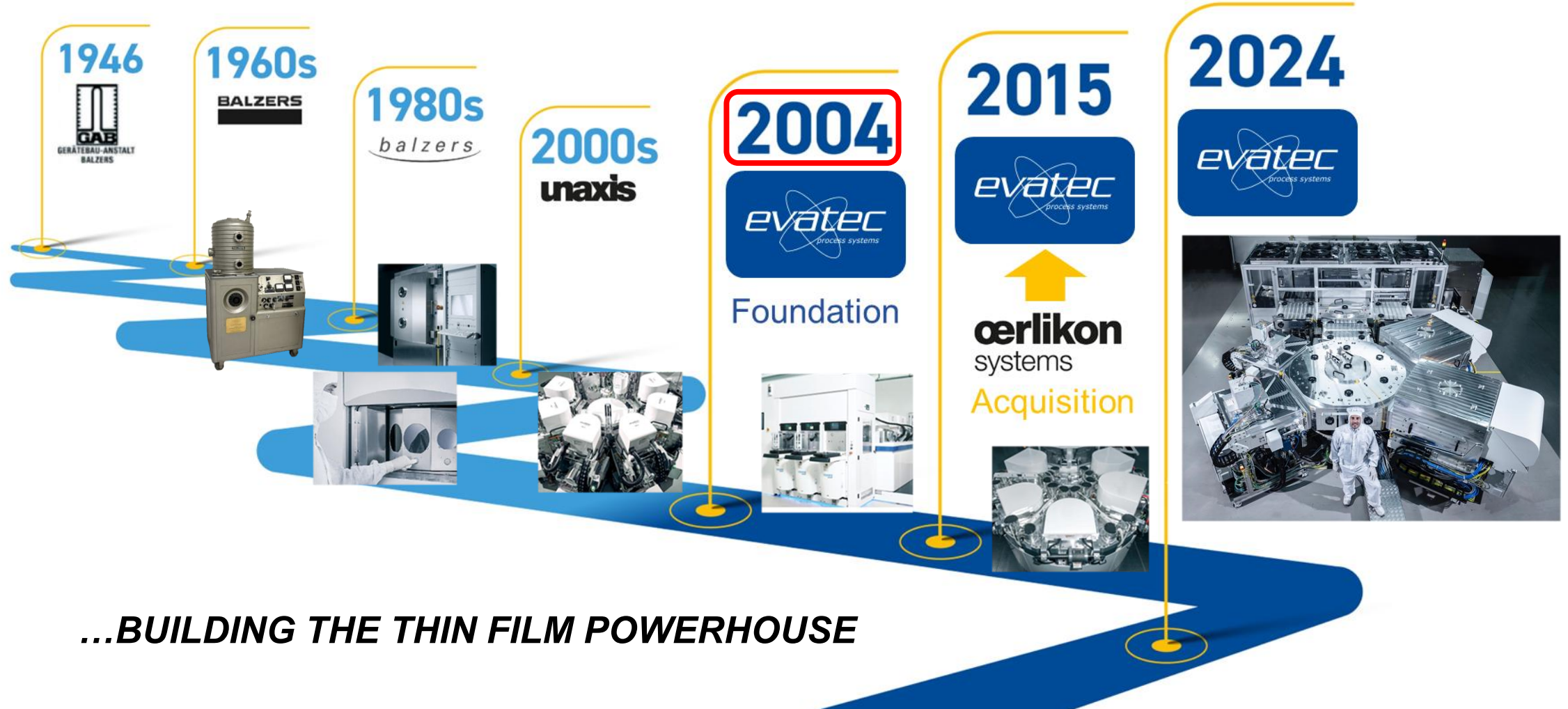
We are the
“**Thin Film
Powerhouse**”!



THE THIN FILM POWERHOUSE

EVAPORATION / PVD / PVE / PECVD / PEALD

>70 YEARS OF CONTINUED INNOVATION...



1

Company introduction
- Who we are

2

Compound Semiconductors at the centre of Evatec's activities
- History and Expertise

3

Motivation for Photonic Integrated Circuits
- From piezo-electrics to electro-optics

4

Evatec's contribution to PIC
- Waveguides and Modulators

5

Outlook for Magnetron Sputter Epitaxy
- Impacting Power Devices, Optoelectronics, Connectivity (6G) and Wafer Level Optics

6

Wrap up
- Key take-aways

TECHNOLOGY DISRUPTIONS ARE BUILT ON SEMICONDUCTORS



ARTIFICIAL INTELLIGENCE



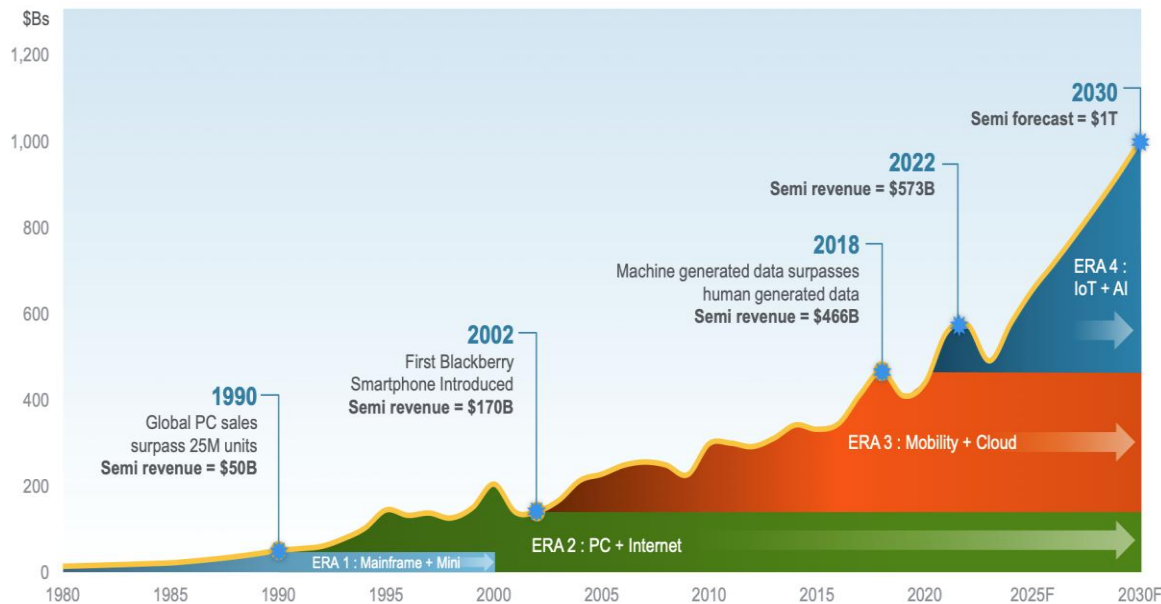
INTERNET OF THINGS



**ENERGY
TRANSFORMATION**



**ELECTRIC AND
AUTONOMOUS DRIVING**



Source: DIGITIMES, Gartner, SEMI, Feb 2024

PLATFORMS: BATCH / CLUSTER / INDEXER



BATCH



BAK

Family of evaporators from 0.5 to 1.4 meters with wide range of process sources and with "Autoload" options



LLS EVO II

Vertical sputter for metals, dielectrics, and magnetic films



CLUSTER



CLUSTERLINE® 200

200mm cluster platform with configuration options for 6 single substrate or batch processing



CLUSTERLINE® 300

300mm platform including AFEM with configuration options for 6 single wafer processing modules



CLUSTERLINE® 600

FOPLP & IC substrate manufacturing on a cluster tool for panel handling up to 650x650mm



INLINE



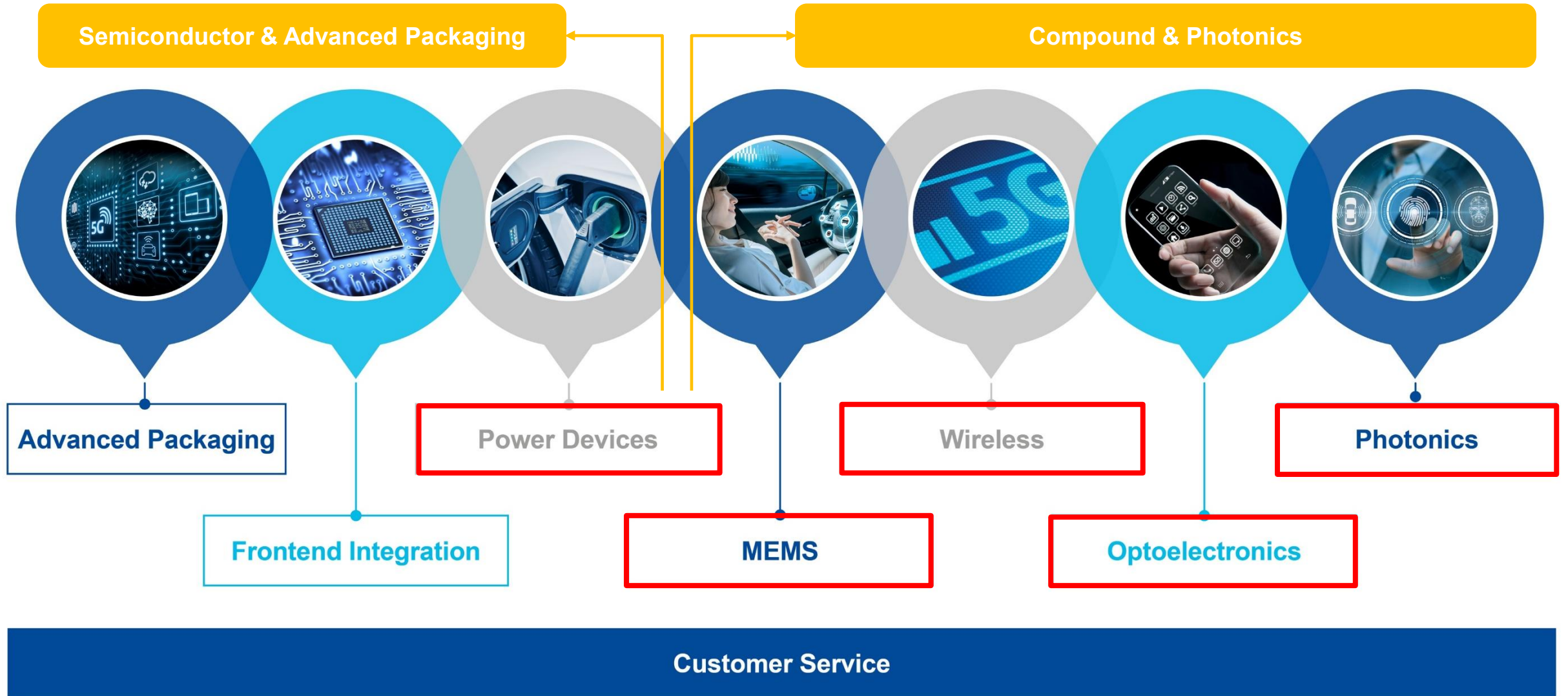
HEXAGON

Your cost advantage in wafer level packaging processes

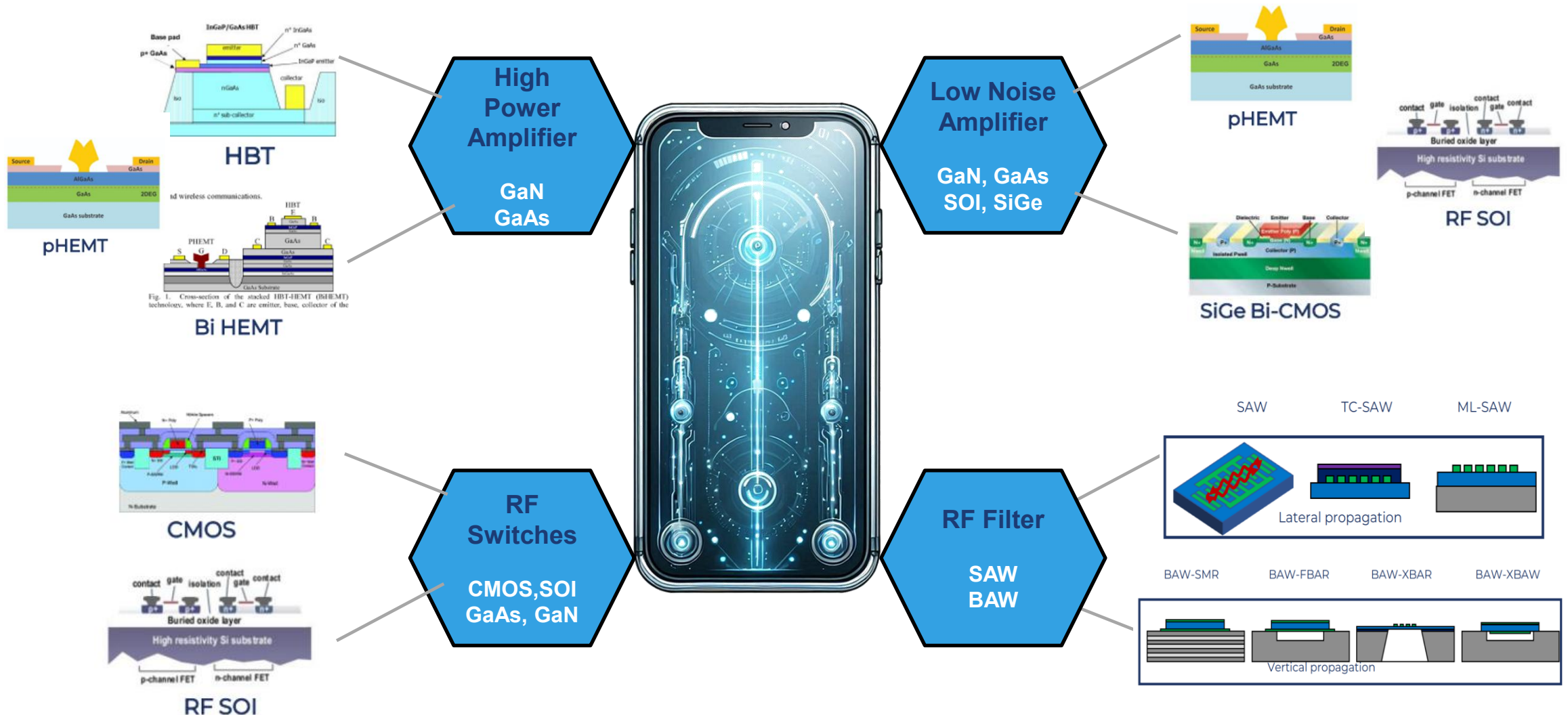


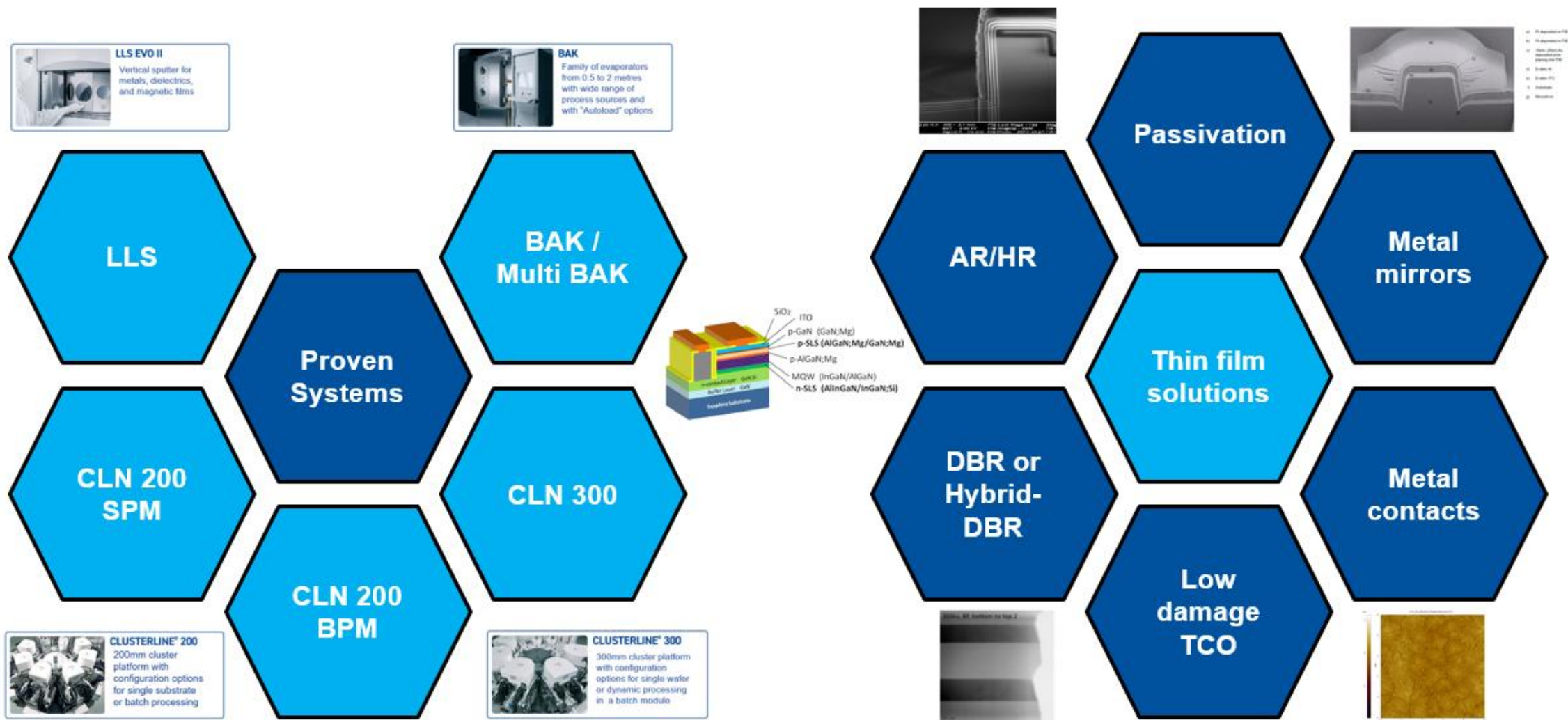
SOLARIS®

Family of platforms for fully automated high speed inline sputtering in single substrate chambers

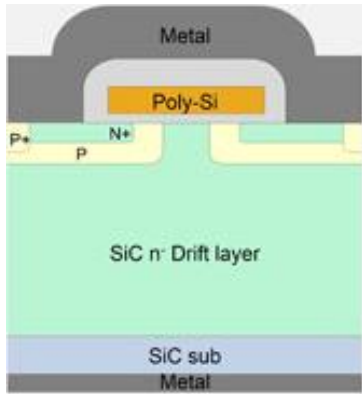


THIN FILM SOLUTIONS IN RF FRONT END AND WL MARKET

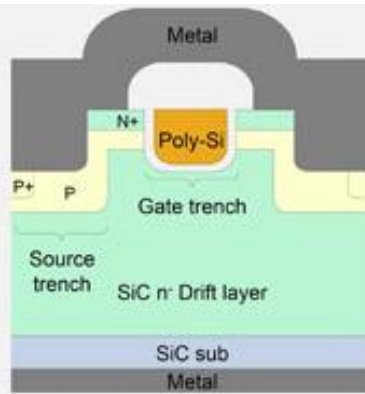




Planar SiC MOSFET

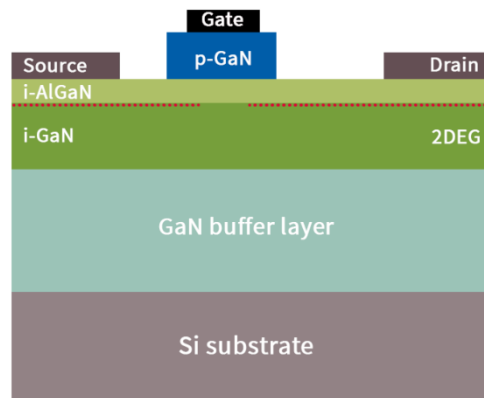


Trench SiC MOSFET

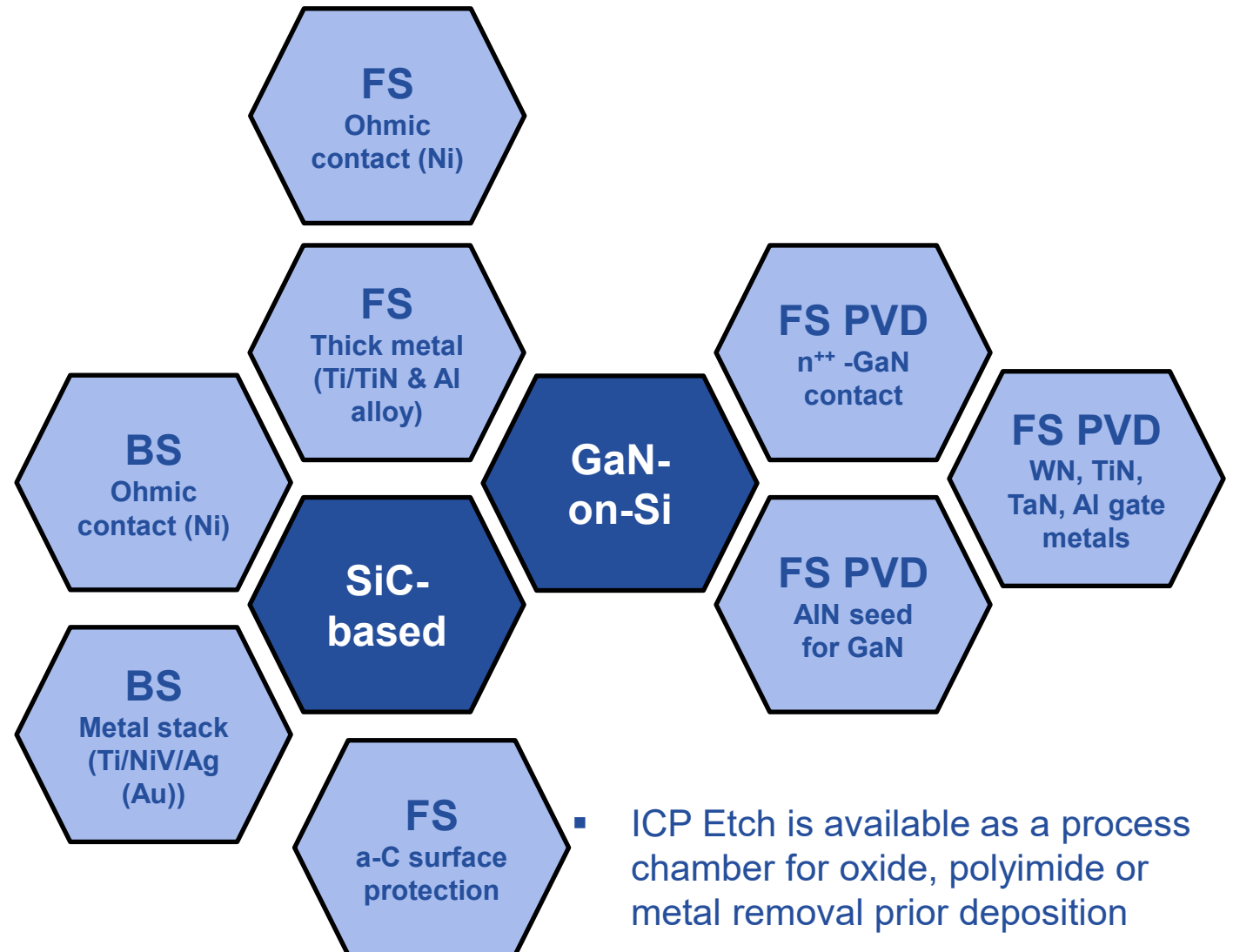


Source: Rohm Semiconductor

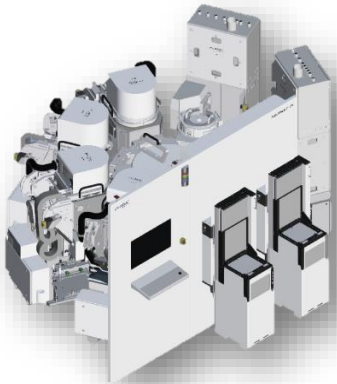
GaN-on-Si HEMT



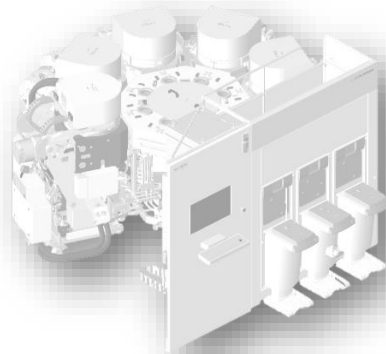
Source: Infineon



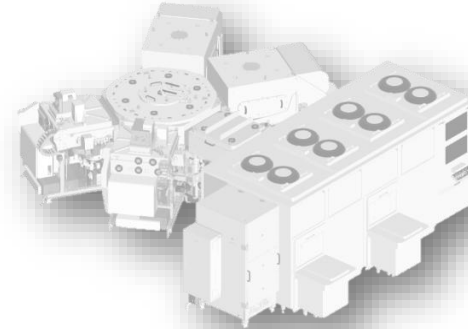
CLUSTERLINE® 200



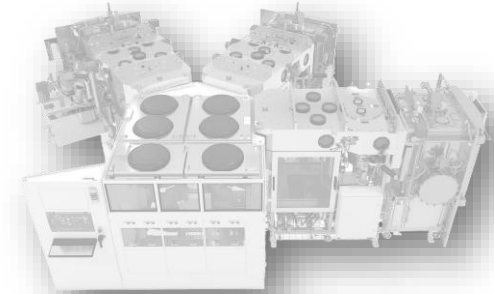
CLUSTERLINE® 300



CLUSTERLINE® 600



Multi BAK / Evaporators



PECVD

PVD
ARQ 320

PEALD

BPM

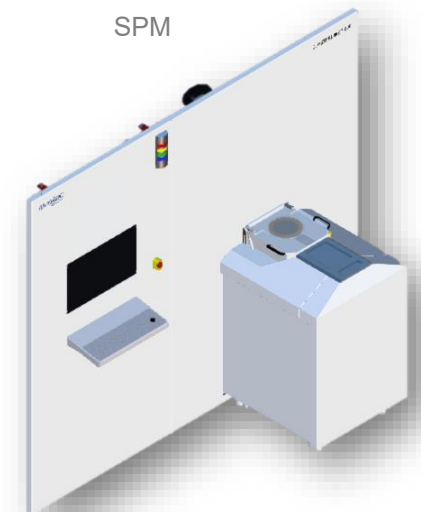
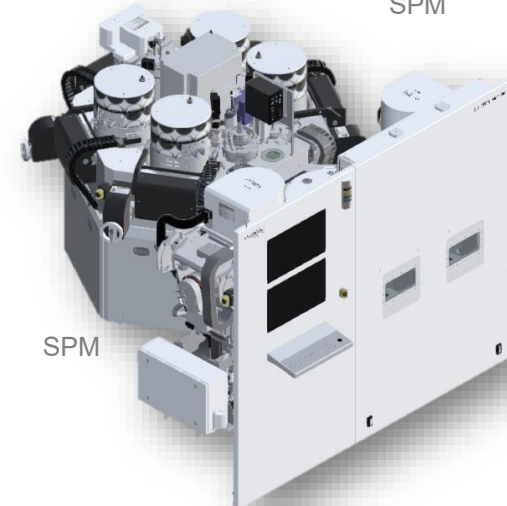
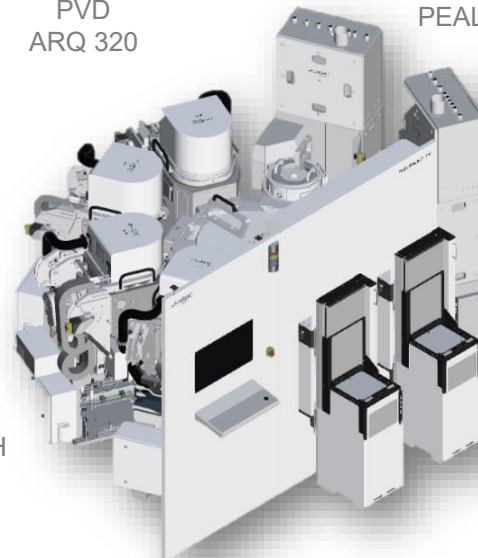
SPM

SPM

MSQ

PVD

ETCH



**Best In
Process Flexibility**

**Best In
Hard and Software
Flexibility**

1

Company introduction
- Who we are

2

Compound Semiconductors at the centre of Evatec's activities
- History and Expertise

3

Motivation for Photonic Integrated Circuits
- From piezo-electrics to electro-optics

4

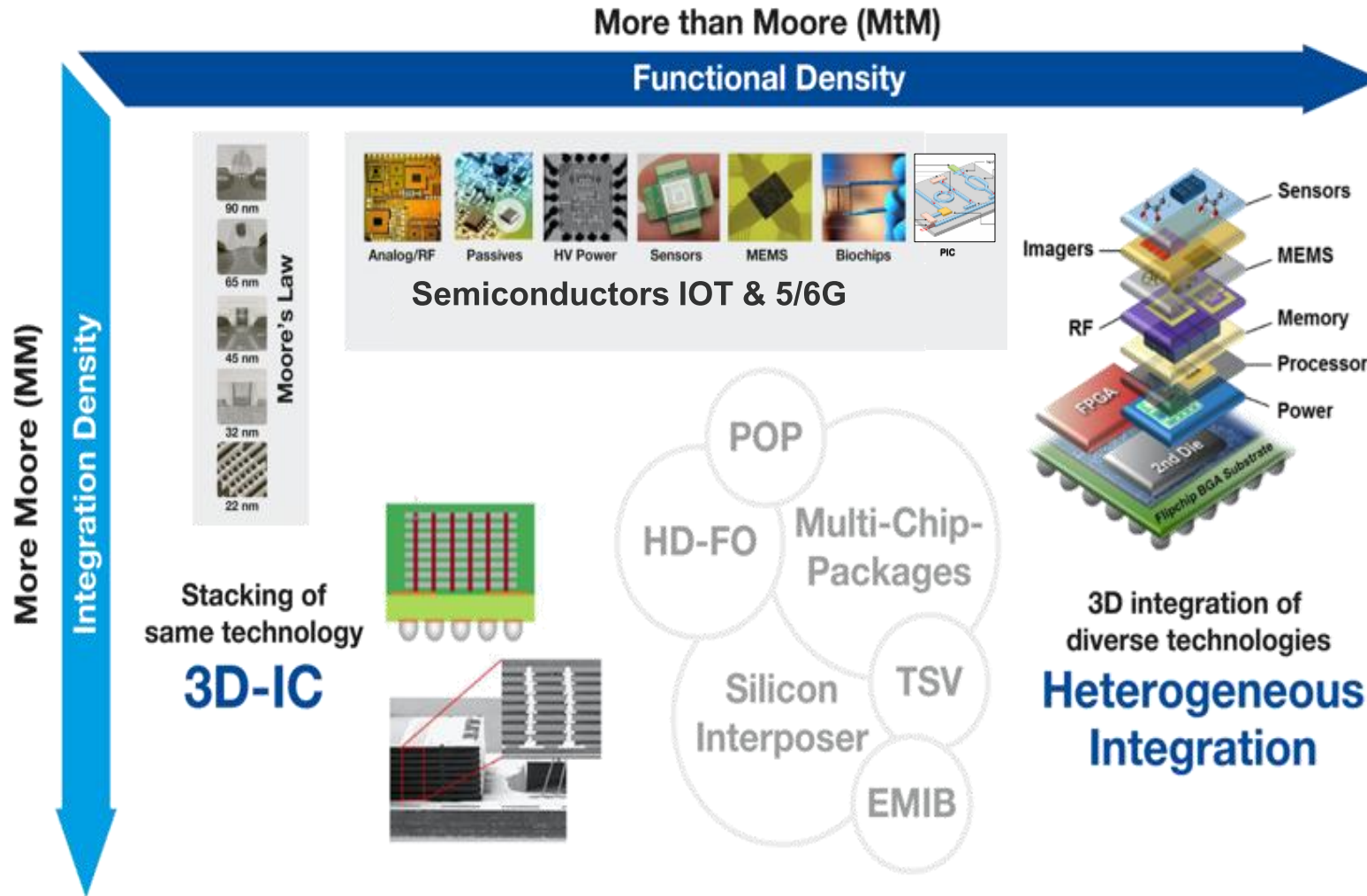
Evatec's contribution to PIC
- Waveguides and Modulators

5

Outlook for Magnetron Sputter Epitaxy
- Impacting Power Devices, Optoelectronics, Connectivity (6G) and Wafer Level Optics

6

Wrap up
- Key take-aways



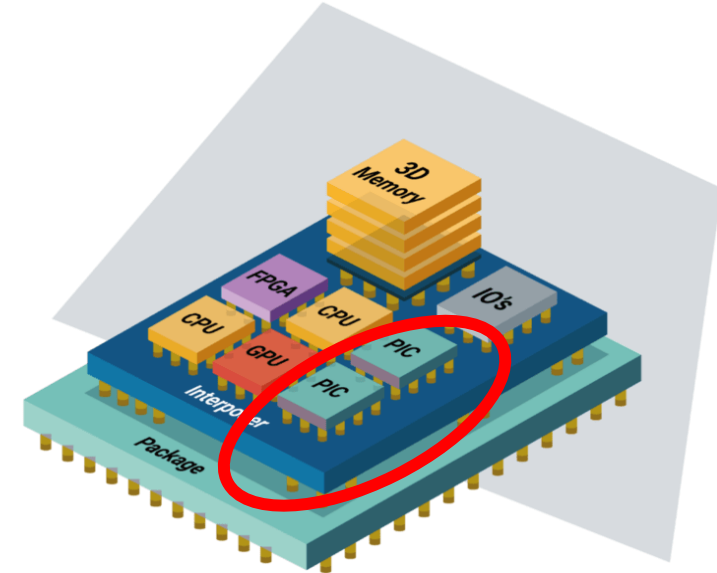
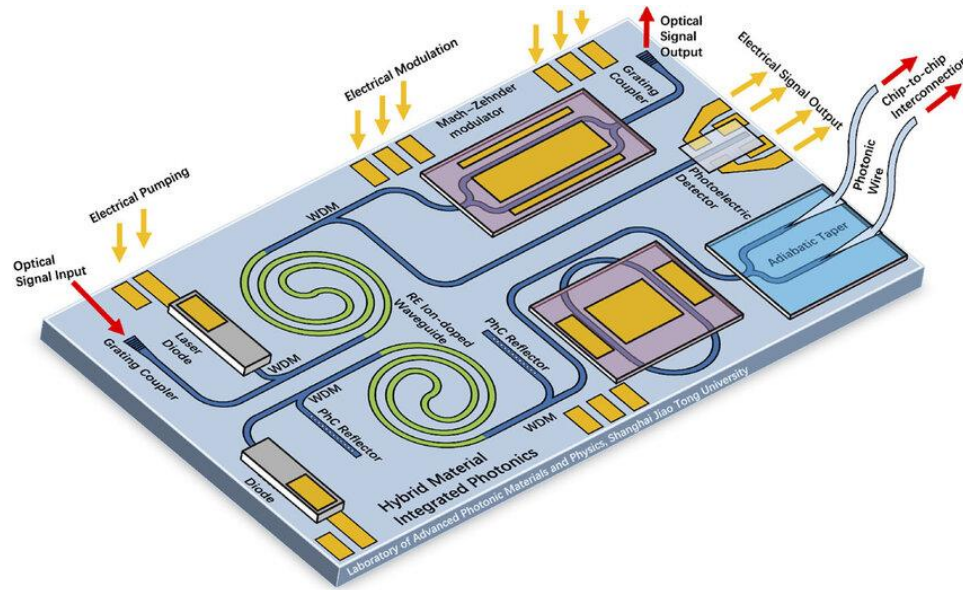
Our roots and expertise are based in the More-than-Moore axis.

We complement this know-how with Frontside-capabilities and significant footprint in Advanced Packaging – to be **ready on chiplet-level AND 3D Heterogeneous Integration**

Market Segments	MEMS	Wireless	Power	WLO
Materials	AlN, AlScN, PZT, KNN	AlN, AlScN, SiGe, LiNbO3, (LiTaO3)	(GaN)	LiNbO3, BaTiO3, AlScN
Properties	Highest crystallinity, quasi-epitaxy for all materials			
Seeding	t.b.d.	t.b.d.	Hot AlN buffer	SrTiO3 for BTO

Functional breakdown to recognise synergies

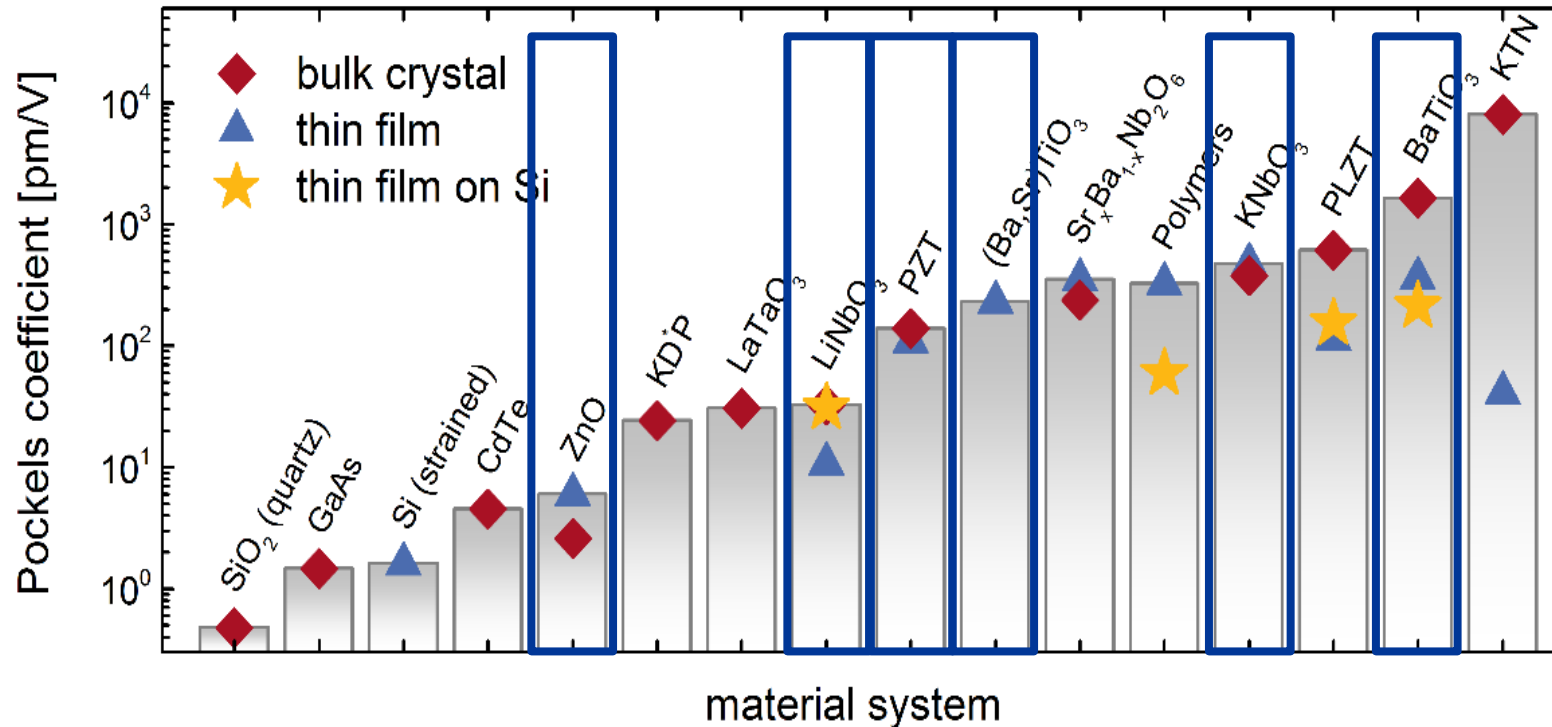
Material Class	„Functional Ceramics“ (e.g. Perovskites, ...) / multi-ferroics / epitaxial ferroelectrics
HW features	Temperature, Low Energy Impact, Seeding
	Grey Area of Advanced PVD, MOCVD and MBE MAGNETRON SPUTTER EPITAXY



PICs serve as yet another ,chiplet‘ and become part of the general topic of 3D Heterogeneous Integration:

Wafer Level Optics AND Co-Packaged Optics

Inorganic Electro-optic materials



Comparison of literature values for the Pockels effect in bulk crystals and thin films for various material systems [3] reproduced in Silicon photonics, IBM Research Zurich

A wide variety of materials exhibit an electro-optic effect

Pockels effect:

- Strength of refractive index change of a material with an applied electric field
- Hence the possibility to switch and modulate light

Evatec's Experience in Sputtering

Decades in the field for these materials, not always for the electro-optic properties, though.

Established Technology

Molecular Beam Epitaxy (MBE)

- High crystalline quality BaTiO_3 with high Pockels effect demonstrated
- **Drawbacks:** low deposition rates, challenging to scale MBE up to large volume production



Innovative Evatec Technology

Expected advantages of FTC Sputter deposited BaTiO_3

- High crystalline quality BaTiO_3
- Stoichiometric, low roughness, low optical loss ...
- High Pockels effect
- Ability to grow the material in volume production

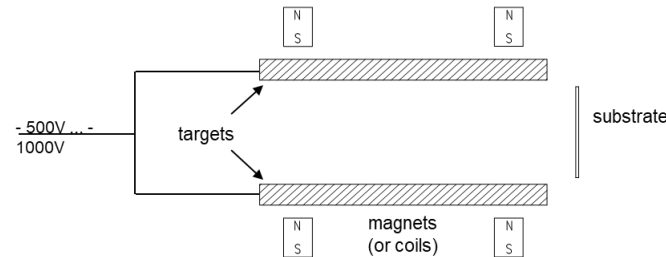
CLUSTERLINE® 300



Combining Evatec's proprietary Low Energy Impact FTC source with Very Hot Chuck



Heater up to 750°C



RF/DC power reduces plasma potential to $\approx 40V$
→ Lower energy for negative oxygen ions (O_{neg})

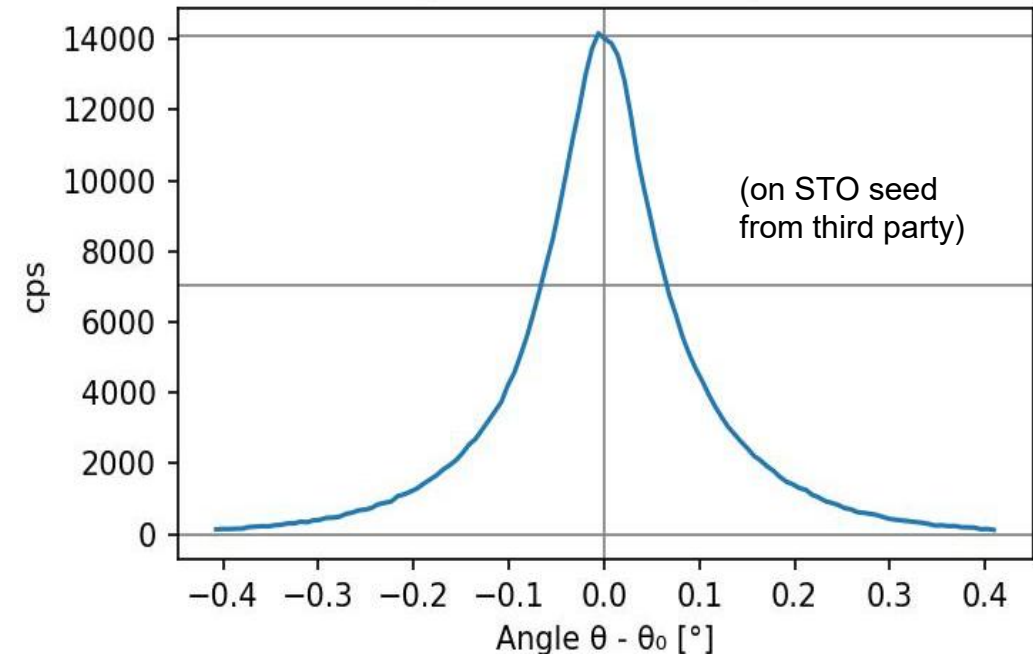
Expected advantages of PVD – BaTiO₃

- Ability to grow the material in volume production
- Semiconductor compatibility

Challenges

- High crystalline quality BaTiO₃
- Stoichiometric, low roughness, low optical loss
- High Pockels coefficients

Results: Quasi-Epitaxial BTO



XRD: In-plane orientation tunable, **RC < 0.13°** (as grown)

Pockels effect > 800pm/V

1

Company introduction
- Who we are

2

Compound Semiconductors at the centre of Evatec's activities
- History and Expertise

3

Motivation for Photonic Integrated Circuits
- From piezo-electrics to electro-optics

4

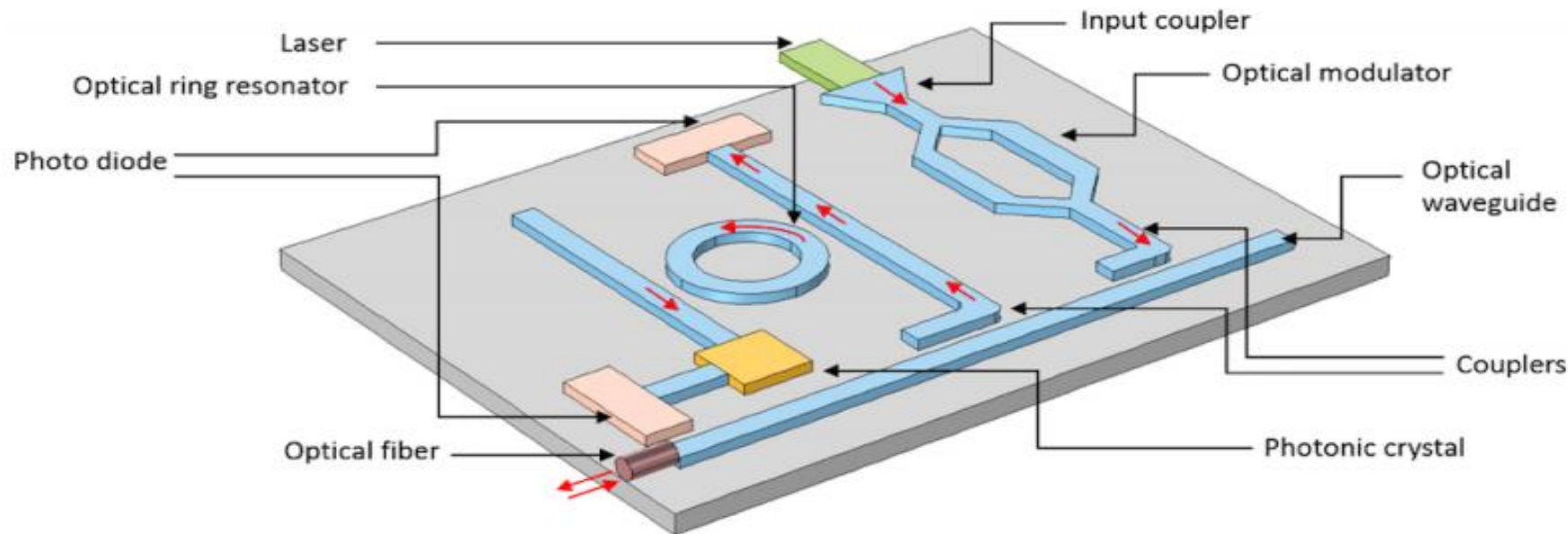
Evatec's contribution to PIC
- Waveguides and Modulators

5

Outlook for Magnetron Sputter Epitaxy
- Impacting Power Devices, Optoelectronics, Connectivity (6G) and Wafer Level Optics

6

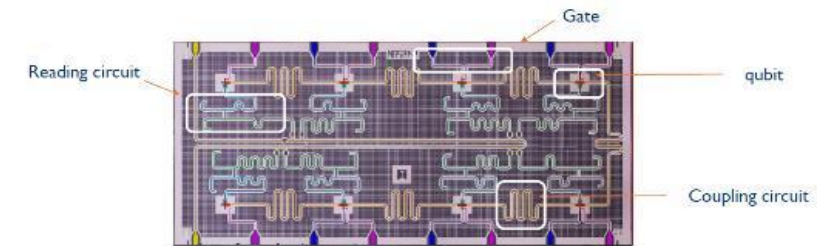
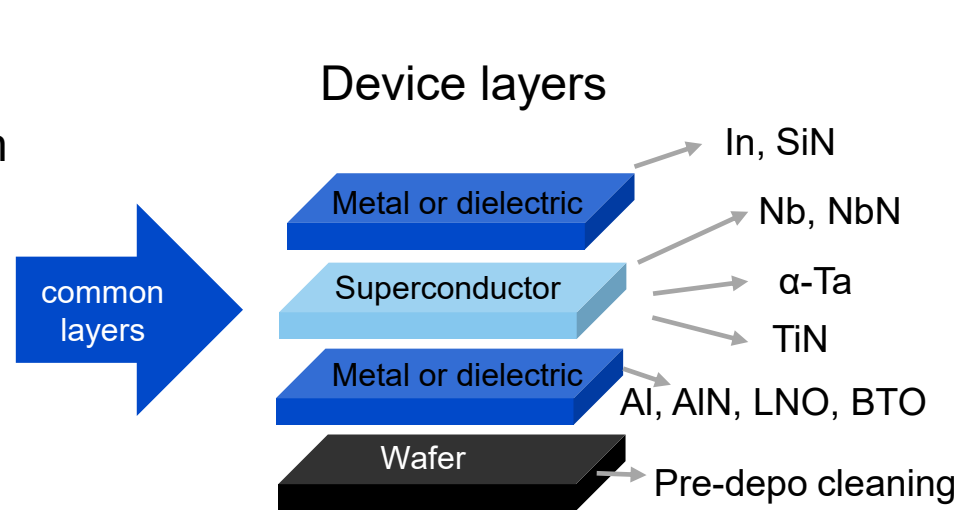
Wrap up
- Key take-aways



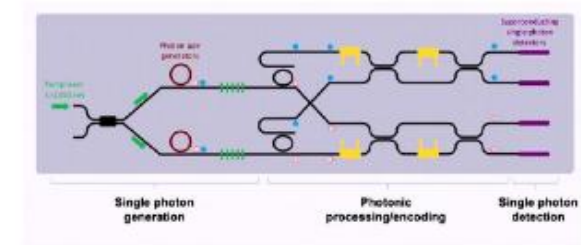
- Laser, LED light sources with DBRs for AR, HR (Optical Interference Coatings)
- Waveguides based on Silicon Nitride and Aluminium Nitride
- Electro-optic materials for modulators based on Barium Titanate and Lithium Niobate
- Metal contact layers
- Co-Packaged Optics

Illustration : [Silicon Photonics: Designing and Prototyping Silicon Waveguides | COMSOL Blog](#)

- Superconductors
- Photonic Quantum Computing
- Spin qubits
- Quasi particles
- NV centers
- Trapped ions
- Cold atoms



Superconducting qubit processor from ETH Zurich



Example of fully quantum photonic chip by Leti



- Superconductor material is an essential layer either as an active qubit element or to reduce the noise
- Degas and cleaning of deposition surface with low-damage
- Deposition at low pressure, optional integrated oxidation
- Vias filling or deposition over 3-D structures can be needed

1

Company introduction
- Who we are

2

Compound Semiconductors at the centre of Evatec's activities
- History and Expertise

3

Motivation for Photonic Integrated Circuits
- From piezo-electrics to electro-optics

4

Evatec's contribution to PIC
- Waveguides and Modulators

5

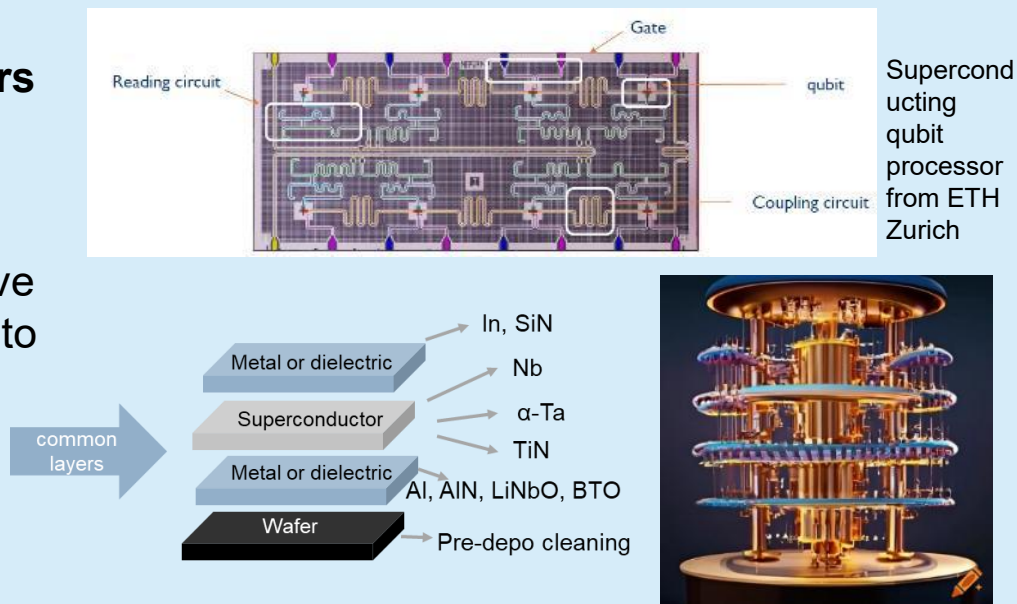
Outlook for Magnetron Sputter Epitaxy
- Impacting Power Devices, Optoelectronics, Connectivity (6G) and Wafer Level Optics

6

Wrap up
- Key take-aways

Superconductors for quantum computing

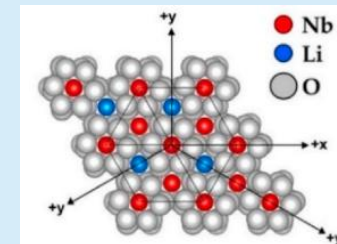
Either as an active qubit element or to reduce the noise



PVD – LiNbO₃ (LNO)

Literature shows examples of epitaxial, stoichiometric LiNbO₃ and potential low waveguide losses

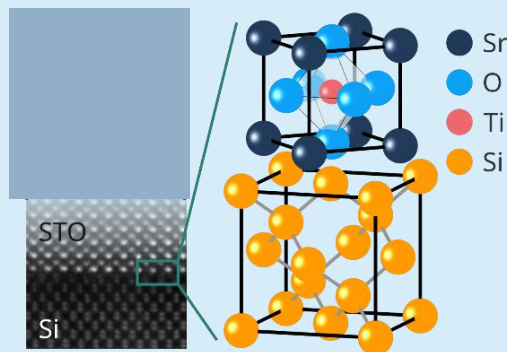
Applications: PIC (WLO) and acousto-optics (RF)



LiNbO₃:
rhombohedral/hexagonal unit cells

Seeding / Lattice Matching SrTiO₃ (STO)

E.g. SrTiO₃ (STO) for BaTiO₃ (BTO) on Si modulators



- Buffer layers for epitaxial diamond on Si
- KNN (K_{0.5}Na_{0.5}NbO₃) as lead-free alternative to PZT
- LiTaO₃, another ferroelectric and piezoelectric material
- MSE in packaging (better dielectrics, barriers, metal contacts and RDLs, heterogeneous integration, ...)
- Thermal management layers (AlN, SiC, Cu, Mo, ...)

1

Company introduction

- Who we are

2

Compound Semiconductors at the centre of Evatec's activities

- History and Expertise

3

Motivation for Photonic Integrated Circuits

- From piezo-electrics to electro-optics

4

Evatec's contribution to PIC

- Waveguides and Modulators

5

Outlook for Magnetron Sputter Epitaxy

- Impacting Power Devices, Optoelectronics, Connectivity (6G) and Wafer Level Optics

6

Wrap up

- Key take-aways

- Magnetron Sputter Epitaxy (MSE) has matured into a robust technology platform suitable for high-volume manufacturing (HVM) across diverse applications, including MEMS, RF, Power Devices, Optoelectronics and Photonics
- Excellent uniformity, repeatability, scalability, and low production costs are mandatory for meeting the stringent demands of industrial production.
- Facing Target Cathode (FTC) sources and multi-source configurations enable flexibility, co-sputtering of complex materials and reduced plasma-induced damage - critical for epitaxial growth and sensitive device layers, providing an ideal bridge from material science to high volume production («from lab to fab»).
- MSE supports next generation applications in Power Devices and Connectivity (6G), as well as emerging applications such as Photonic Integrated Circuits (PICs) and Quantum Computing

EVATEC – A TRUE GLOBAL PLAYER WITH CUSTOMER CENTRICITY



EVATEC North America

EVATEC AG  EVATEC Europe

- EVATEC Japan
- EVATEC China
- EVATEC Taiwan

- EVATEC Malaysia
- EVATEC Singapore

Evatec AG Corporate HQ with focus on Strategy, Product Marketing, Development, Laboratories (ECL) and Operations

Evatec regional Sales and Service organizations (SSO) with Sales, Technical Marketing, Field Service and Support

Visit us at our booth # B1365