

A GaAs/GaN Supply Chain for European Non-Dependence - A Challenge -

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UMS at a Glance

- Founded in 1996 by gathering **THALES** and **EADS** MMICs activities
- Offering MMIC solutions and foundry services for dedicated RF markets
- 58.7 M€ turnover (2012)
- 310 people
- HQ, sales & marketing, product design , back-end production in Villebon
- GaAs and GaN front-end wafer production in Ulm
- Design & customer support in Lowell (USA)
- Sales Office in Shanghai
- ISO 9001, 14001 & TS 16949 certified



Main '*niche*' Market Segments addressed by UMS

strategic

- Phased Array Radar (PAR)
- Electronic Warfare (EW)
- Security applications



Defence & Security

- Communication Satellites
- Earth Observation
- Scientific missions



Space

volume

- LRR 77GHz
- SRR 24/79GHz
- Sensors/tolling Systems



Automotive & Sensors

- Point to Point
- Point to Multi-Point
- VSAT
- BTS

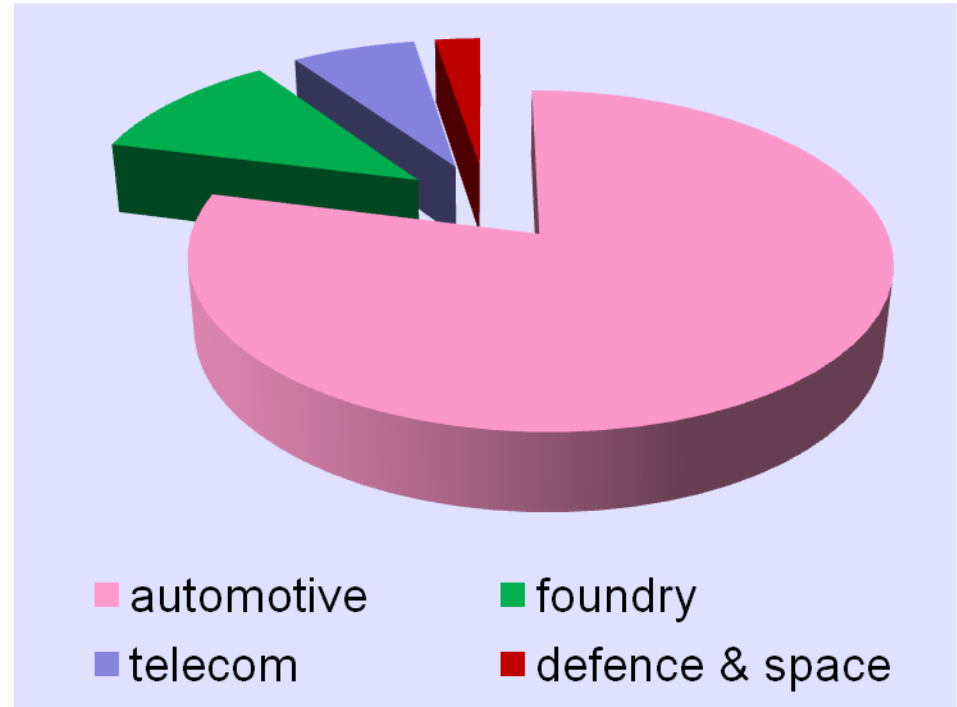


Telecom

Volume vs. Strategic Markets

- **Wafer production status:**

- Q1/2013 (snapshot)
- dominated by automotive production (success of ADAS = Advanced Driver Assistance Systems)
- 86% volume markets (automotive & telecom)
- 11% foundry
- **3% for strategic markets (!!!)**
- low demand for strategic market
 - space – as always, no surprise
 - defence – lack of bigger system procurement projects



- **Volume important:**

- to reduce cost (coverage of CAPEX)
- to stabilise technologies (increasing yield and product quality!)

UMS Technology Portfolio

Research & Development
Industrialization and Qualification
Production
Space Evaluation
Space Evaluated / EPPL

UMS Technology Roadmap		BCB	2011	2012	2013	2014	2015
Low Noise							
Pseudo. HEMT	PH25	x					
Pseudo. HEMT	PH15	x					
Pseudo. HEMT	PH10	x					
Power							
Power PHEMT	PPH25	x					
Power PHEMT	PPH25X	x			2013: Improvements in gain and linearity		
Power PHEMT	PPH15	x					
Power PHEMT	PPH15X	x			2013: Improvements in gain and linearity		
Power HBT	HB20S						
Power HBT	HB20P						
Power HBT	HB20PX						
GaN							
GaN HEMT	GH50				4" in 2013		
GaN HEMT	GH25 (4")						
Other functions							
MESFET	HP07	(x)					
VCO/digital HBT	HB20M	x					
Mixer / Schottky	BES	x					
Passive Process	ULRC	x					

- various technologies for all kinds of applications
- nearly all technologies are space evaluated (in EPPL)

GaAs/GaN Supply Chain

● Supply Chain includes

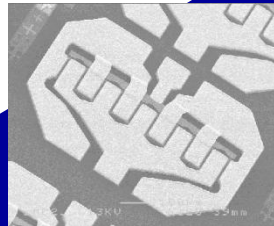
- substrate (GaAs/SiC)
- epi-wafer (epitaxial growth of heterostructures on substrate)
- device and MMIC manufacturing (lateral structuring and processing of epi-layers)
- back-end activities (device/MMIC test, inspection, dicing)
- packaging/assembly (mounting of device/MMIC in package/module)



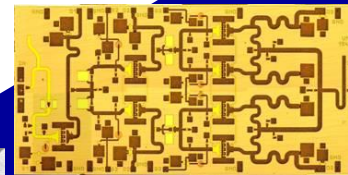
SUBSTRATES



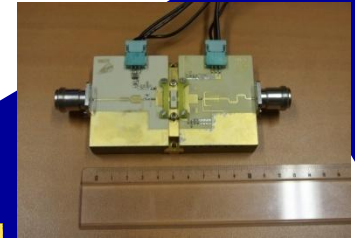
EPITAXY



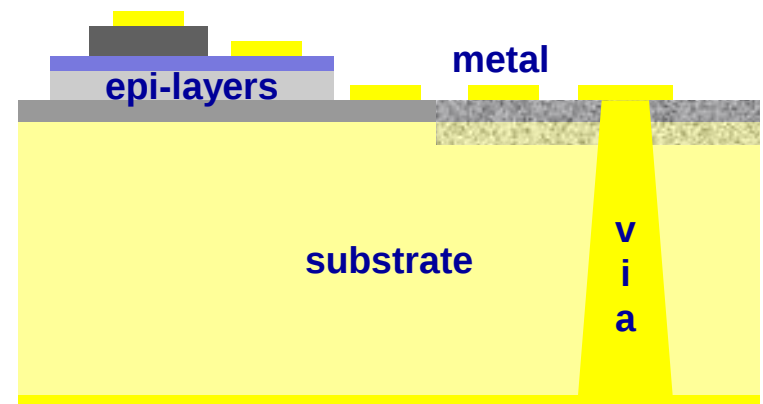
DEVICES



MMIC



INTEGRATION



GaAs/GaN Supply Chain Requirements

- **GaAs/GaN RF device/MMIC supply for European Non-Dependence**
 - develop state-of-art technologies (GaAs PHEMT, Schottky, MESFET, HBT and GaN HEMT) for a wide range of applications
 - ensure highest performance and quality in production
 - minimize/avoid US and other critical materials in the supply chain (including tools, raw materials, chemicals)
 - become strategic supplier for European defence and space stakeholders
 - get support from defence and space stakeholders for developments/improvements (industry, ESA, national space agencies, MoDs, ...)

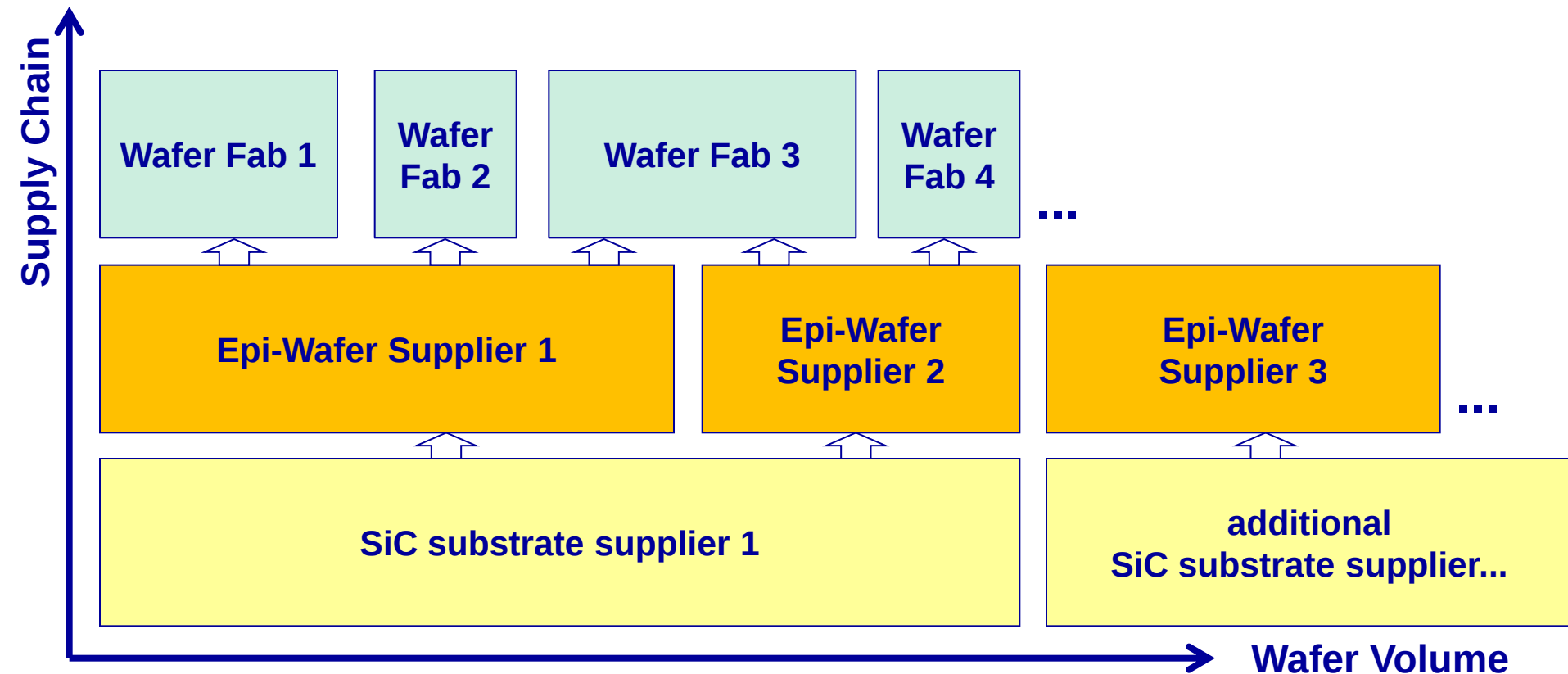
**volume requirement for space and defence in Europe:
around 1.000x 4"-GaAs/GaN RF wafers per year**

- **GaAs/GaN device/MMIC supply to other markets (telecom/automotive)**
 - concentrate on specific technologies/products and optimize cost
 - increase wafer diameter (to reduce cost per component)
 - strive for cost reduction in supply chain (substrate/epi-wafer)
 - minimize R&D and technology changes (including supplies)

GaN Component Supply Chain

● Supply Chain versus Wafer Volume

- high cost of new supplier qualification → limitation to low number of suppliers
- high CAPEX per supply chain step → one supplier needs various customers



GaN Component Supply Chain

● SiC substrates

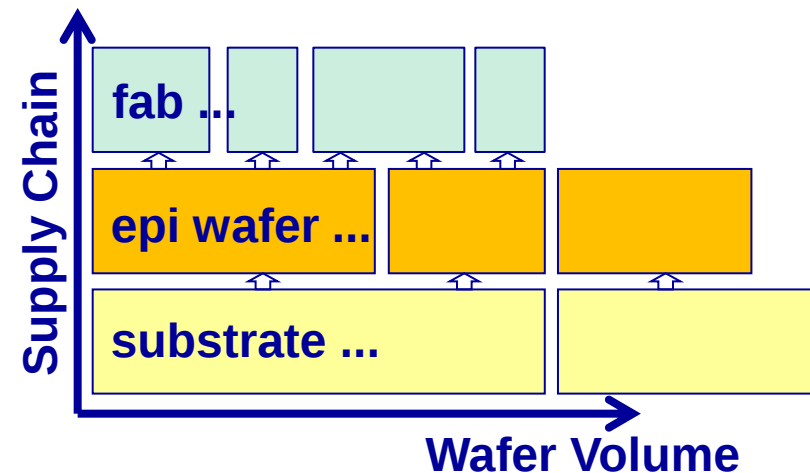
- monthly volume around 10k wafers (4" equivalent) today
- 2/3 of volume for lighting, 1/3 for power electronics (e.g. AC/DC converters)
- only 400 substrates on semi-insulating SiC (needed for RF circuitry)
- Commercial European suppliers: SiCrystal, Norstel, ... (all in development)
- semi-insulating SiC is a "niche"

● Epi-wafers on SiC substrates

- big world wide players: CREE, IQE US, ...
- strong European research base (R&D institutes)
- Commercial European suppliers:
IQE UK, EpiGaN, Soitec, ...
(all in development)

● GaN wafer fab

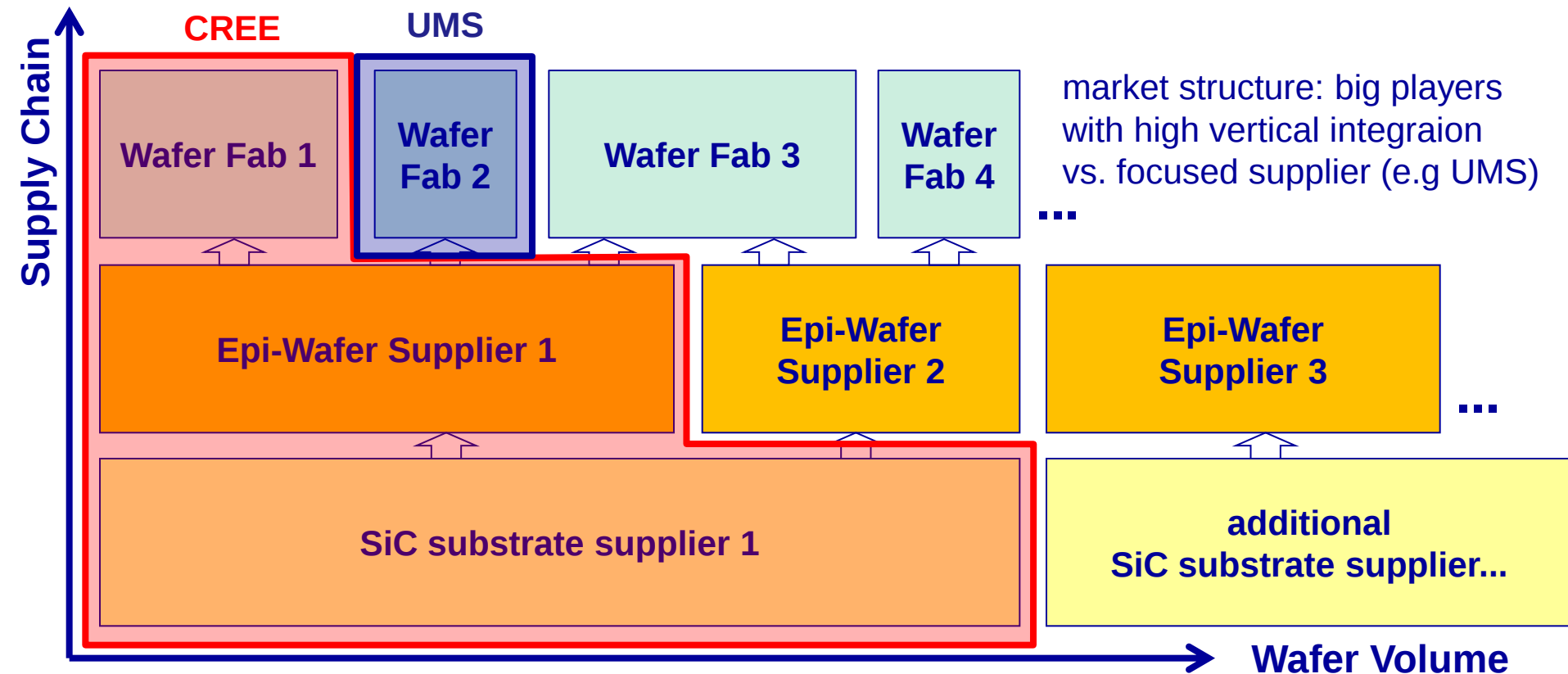
- big players: CREE, Triquint, Sumitomo,
- captive players: Raytheon, ...
- European players: UMS, ...



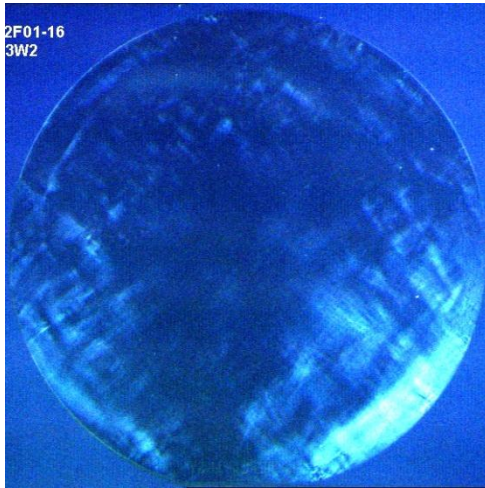
GaN Component Supply Chain

● Suppliers for European Non-Dependence

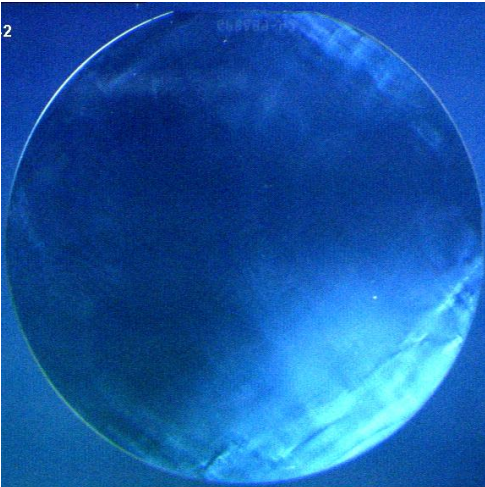
- being competitive (performance, quality, price) on the supply chain level
- broad customer base (worldwide) required in order to create sufficient volume
- self sustaining business (only limited R&D support by European stakeholders)



European SiC Substrate – Results from R&D Projects



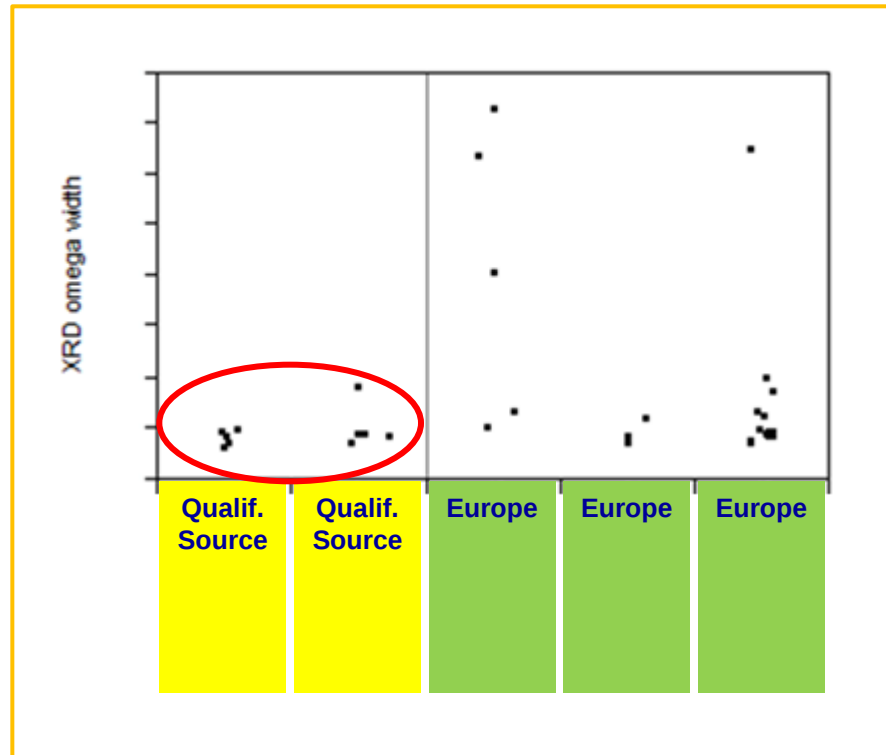
European substrate



Qualified substrate

● SiC Substrate Quality

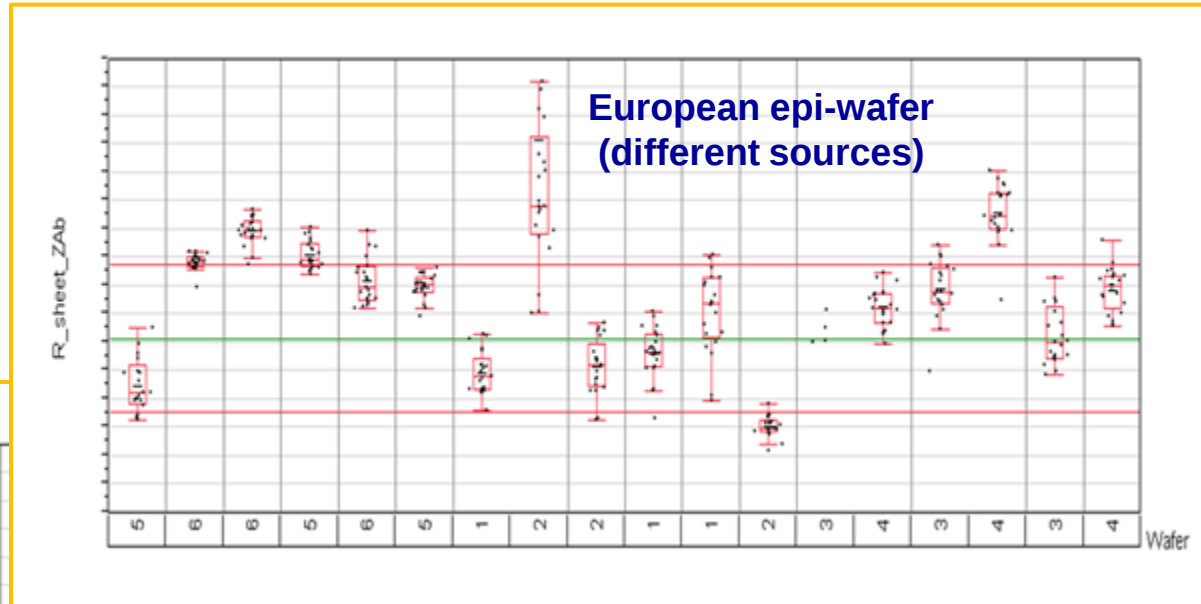
- Line widths from X-ray omega scans for samples on SiC substrates from European Source and the Qualified Source



European Epi-wafer – Results from R&D Projects

● Epi-wafer quality

- low spread required for production to ensure constant device performance
- volume required to reduce spread
- difficult for new suppliers since they have to compete with well established production lines

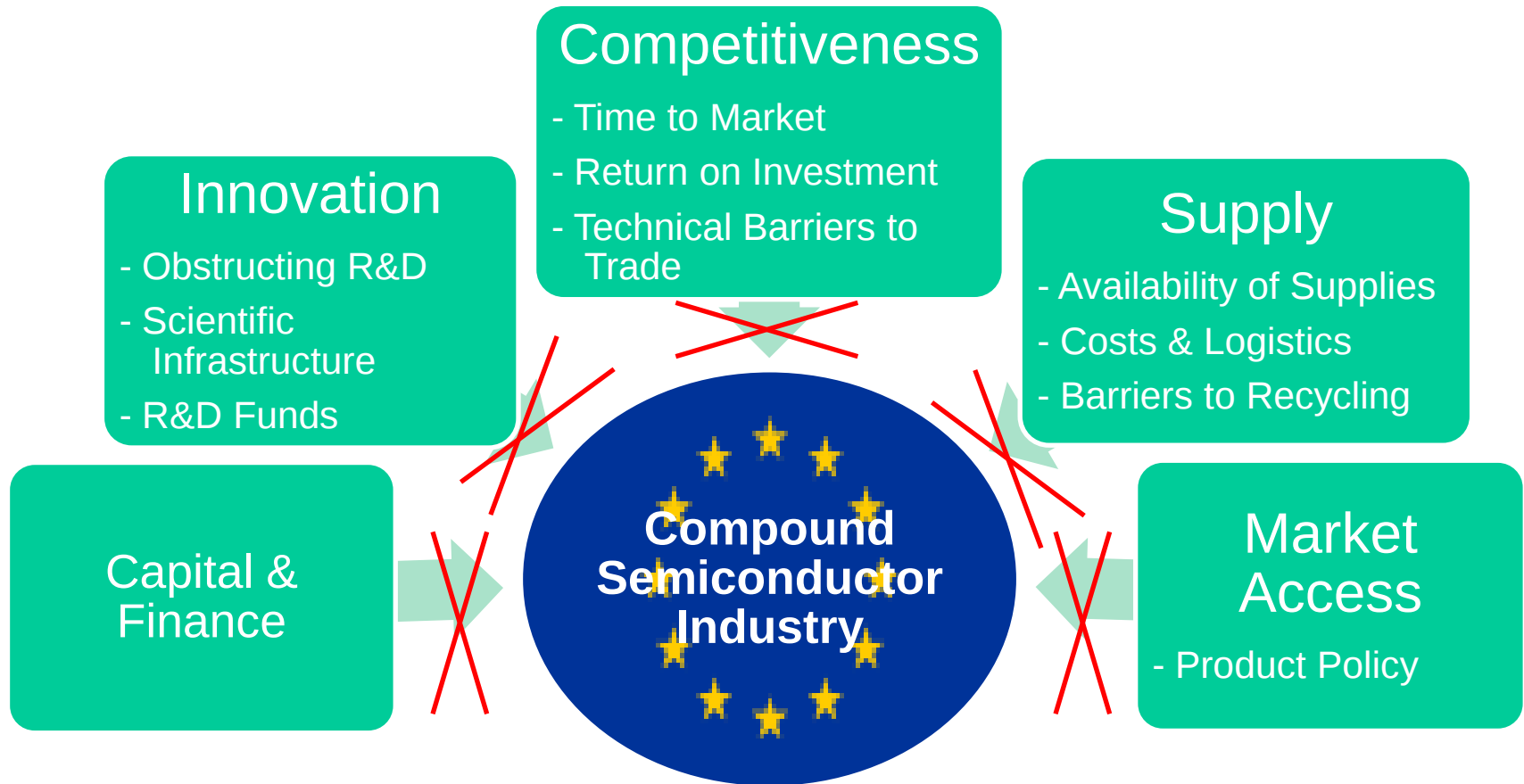


sheet resistance

"Challenges" on top...

- **EU Legislation: CLP Classification, REACH, ...**

- CLP Classification and a potential entry onto SVHC list of GaAs material will be detrimental for Europe's competitiveness and ability to innovate in this market domain



Summary

- **GaAs/GaN RF manufacturing requires a solid and stable supply chain from substrate, epi-wafer till wafer fabrication/processing**
- **Since GaAs/GaN for RF devices/MMICs are important for modern military and space applications, barrier trades are used to secure national strength/leadership → European supply chain required**
- **Volume wafer production required to ensure appropriate cost and quality level and to create self sustaining business
→ other markets need to be identified and successfully entered**
- **Defence and space stakeholders need to use and support Europe supply chain in order to allow new developments and technology improvements**