SOI Technology and Application

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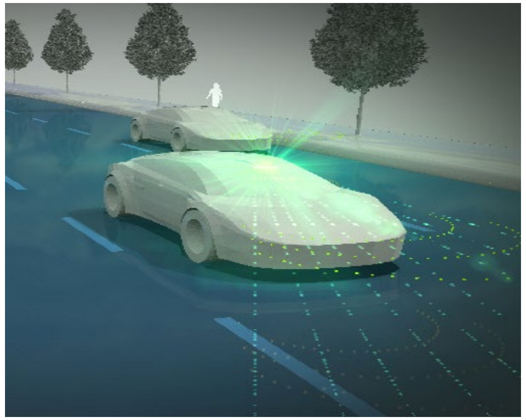
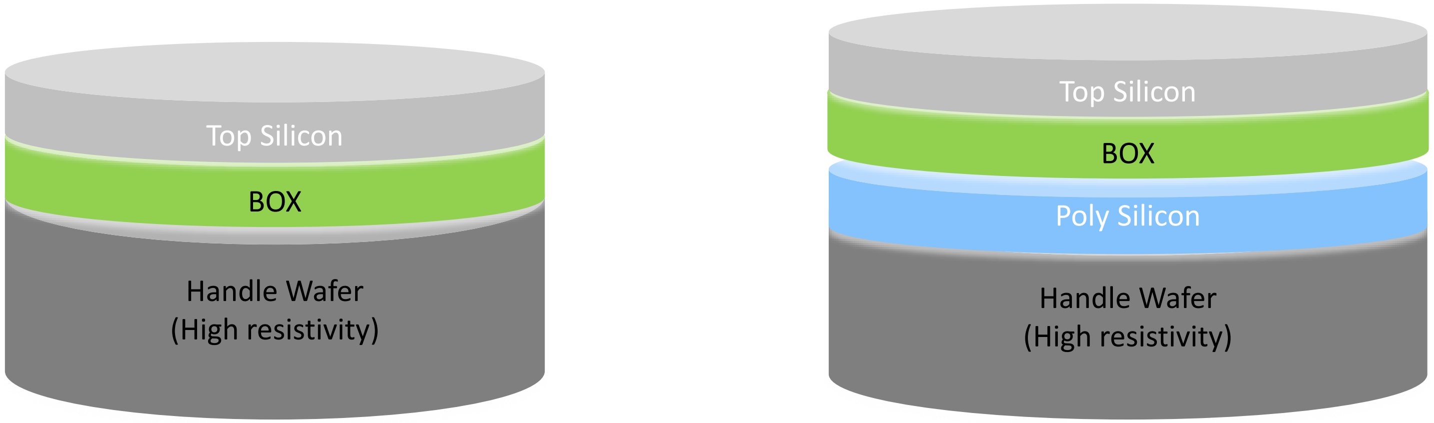
SOI Application

RF	Power	MEMS	Photonics
Antenna switch, Tuners, LNA, PA, etc	Driver, Class-D amplifier, CAN, etc	Lidar， Pressure sensor, Gyroscope, etc	Transceiver, Medical, etc
			

SOI for RF Application

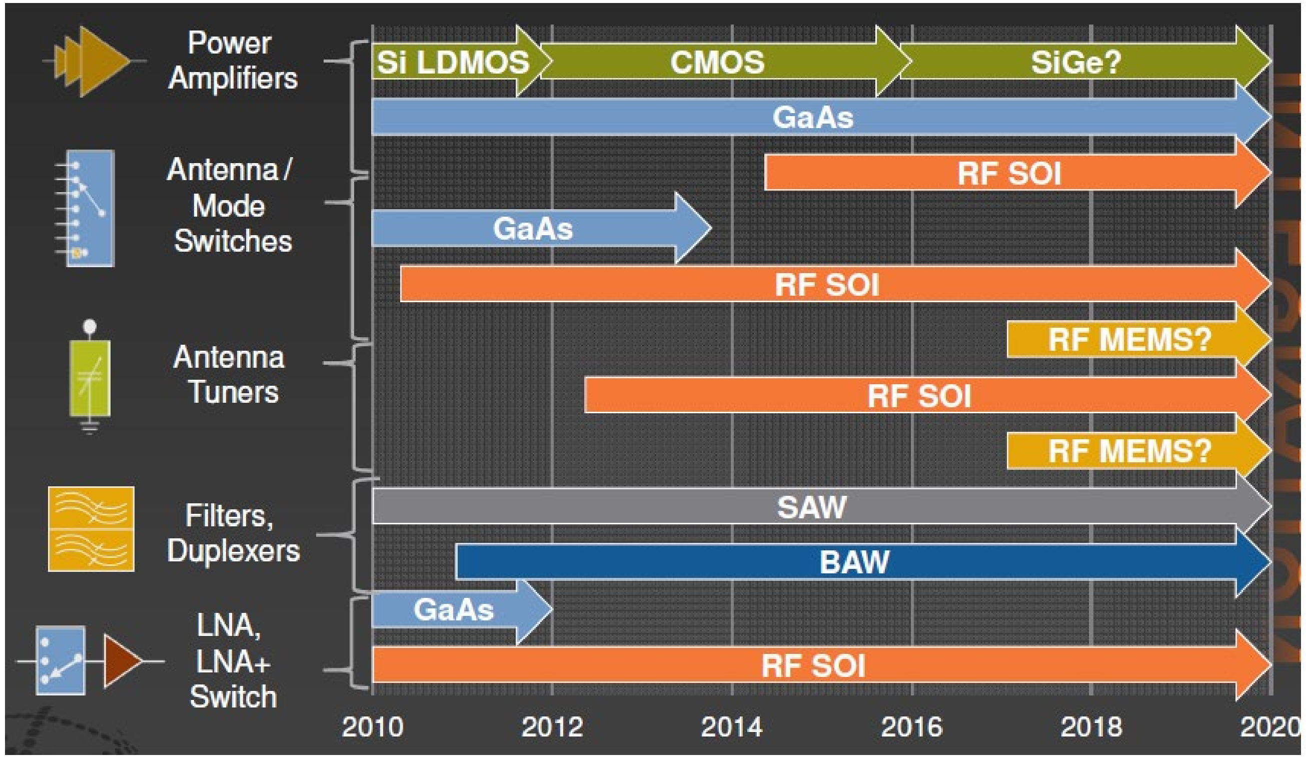


(High Resistivity SOI)

(SOI with poly layer)

- **High resistivity handle wafer to lower harmonic and insertion loss**
- **SOI with poly layer improves RF performance**
  - There is a poly silicon between BOX and handle wafer. This layer allows to trap carriers at BOX-handle interface and to improve the overall resistivity of SOI substrate.
  - Poly layer significantly reduces charge mobility and therefore improves RF performance. While high resistivity SOI targets for 2G and 3G, SOI with poly fits well for 4G and 5G.

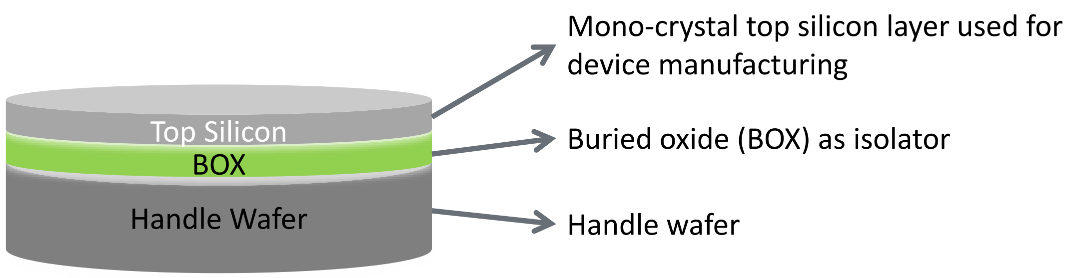
RF-SOI Application Inside FEM



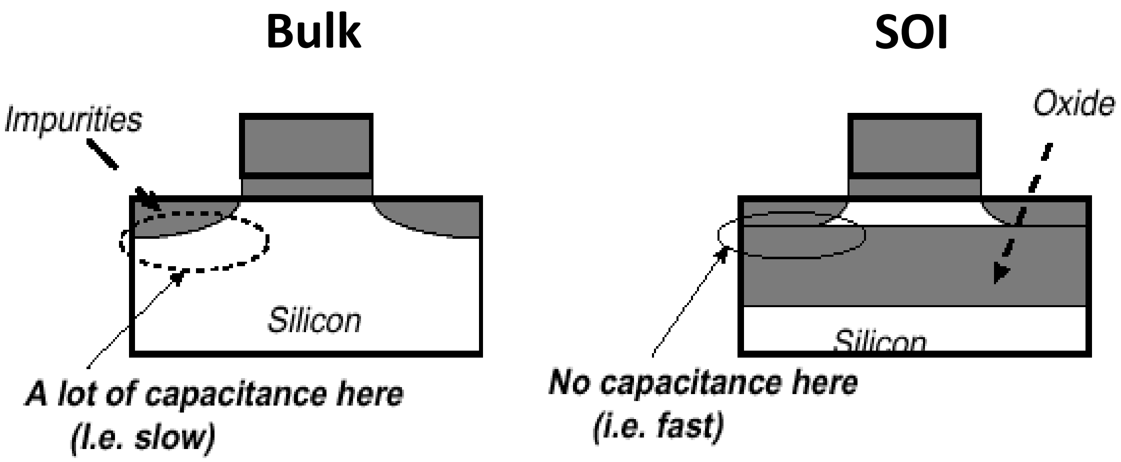
Source: Global Foundries

- RF-SOI has replaced GaAs for switch and LNA and owns 100% market share.
- For PA, RF-SOI is used for low power PA while high power market belongs to GaAs.
- Filter uses acoustic technology namely SAW and BAW.

SOI for Power Application

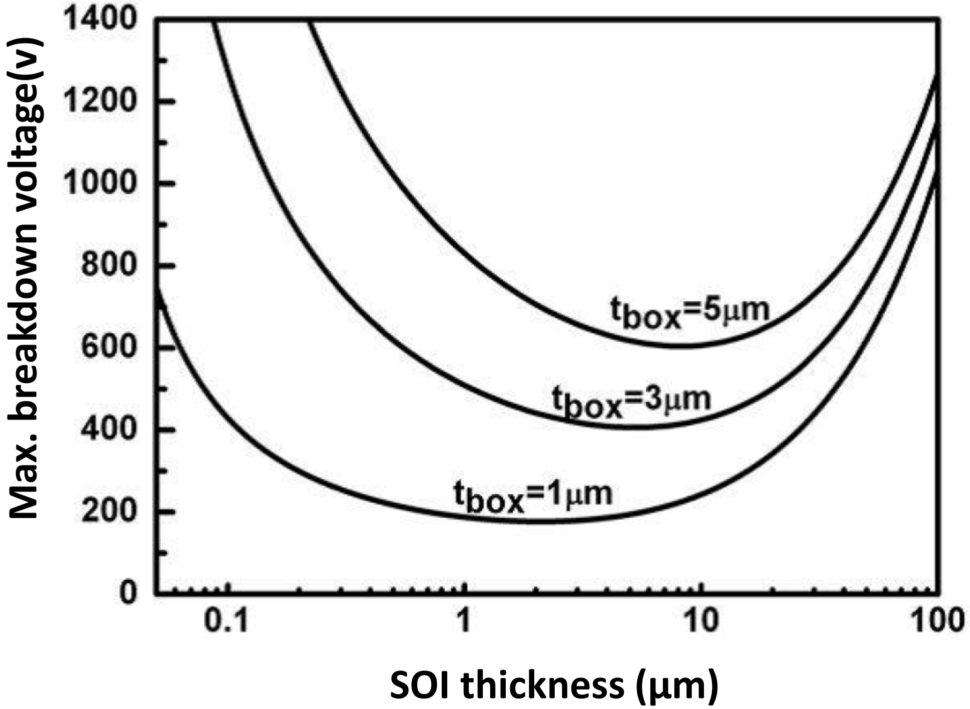


SOI Structure



- **Better performance with SOI structure:**
  - Lower leakage current to reduce energy consumption
  - Good isolation to prevent device from latch-up in CMOS with smaller footprint
  - Faster electric mobility rate

Power Applications



- **Typical SOI product examples:**

01

- Layer Transfer

- SOI THK: ≥0.1 μm
- BOX THK: ≤3 μm

02

- BESOI

- SOI THK: >2 μm
- BOX THK: ≤4 μm

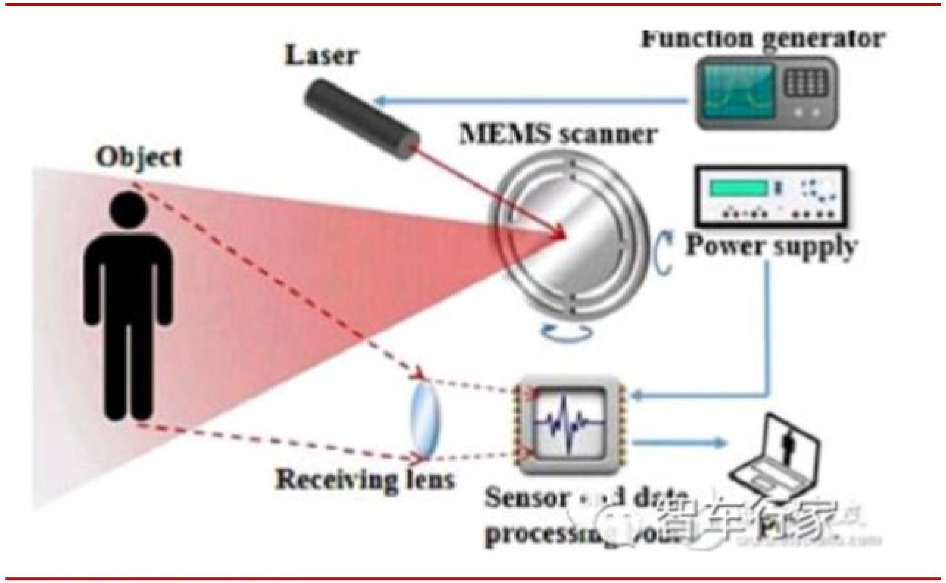
03

- SIMBOND

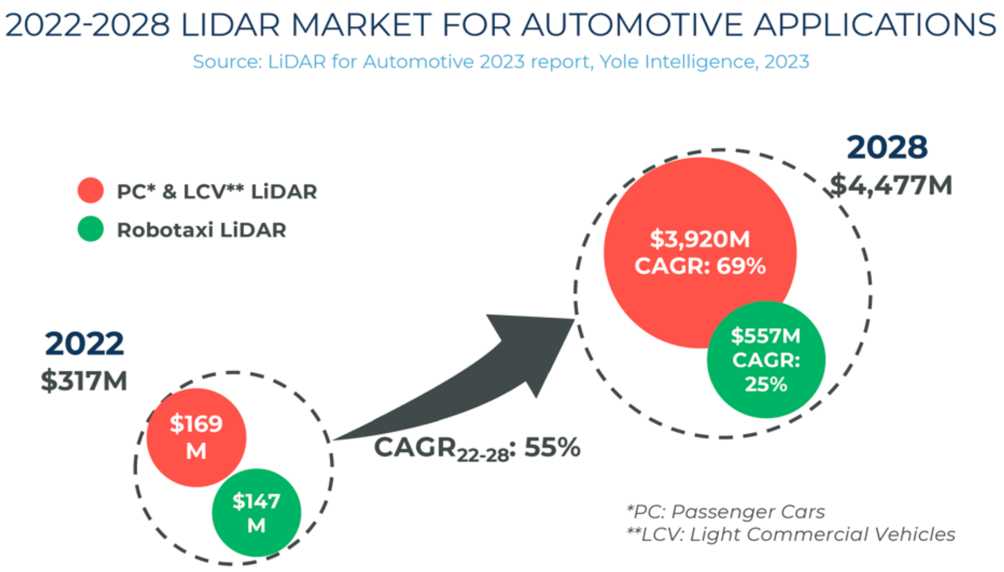
- SOI THK: ≥0.1 μm
- BOX THK: ≤3 μm

- Thicker box has higher breakdown voltage
- Thinner or thicker SOI thickness has higher breakdown voltage under same box thickness

ADAS Lidar MEMS Mirror Market —SOI Opportunity



资料来源：智车行家

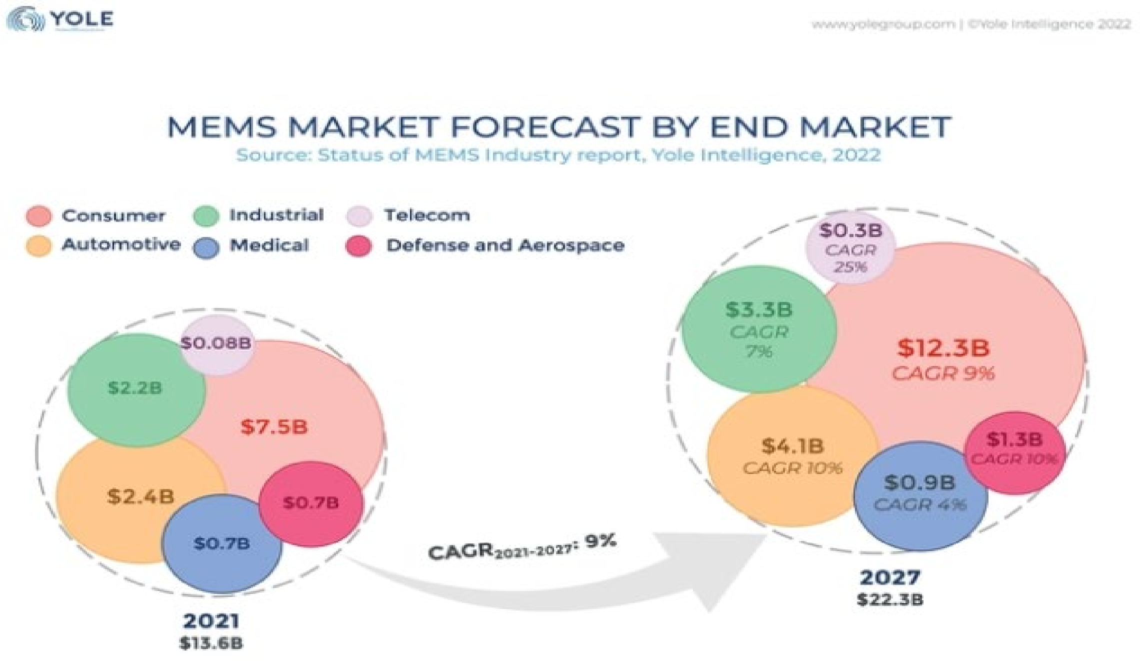


Data Source: Yole

- SOI is a major substrate technology for MEMS mirror in ADAS Lidar.
- Automotive Lidar market will increase from $317 million in 2022 to $4,477 million in 2028, it is expected to reach **CAGR2022-2028 55%** by forecast.
- **Simgui SOI for ADAS Lidar MEMS has successfully mass-produced and applied to China domestic car maker.**

Market Trend for MEMS

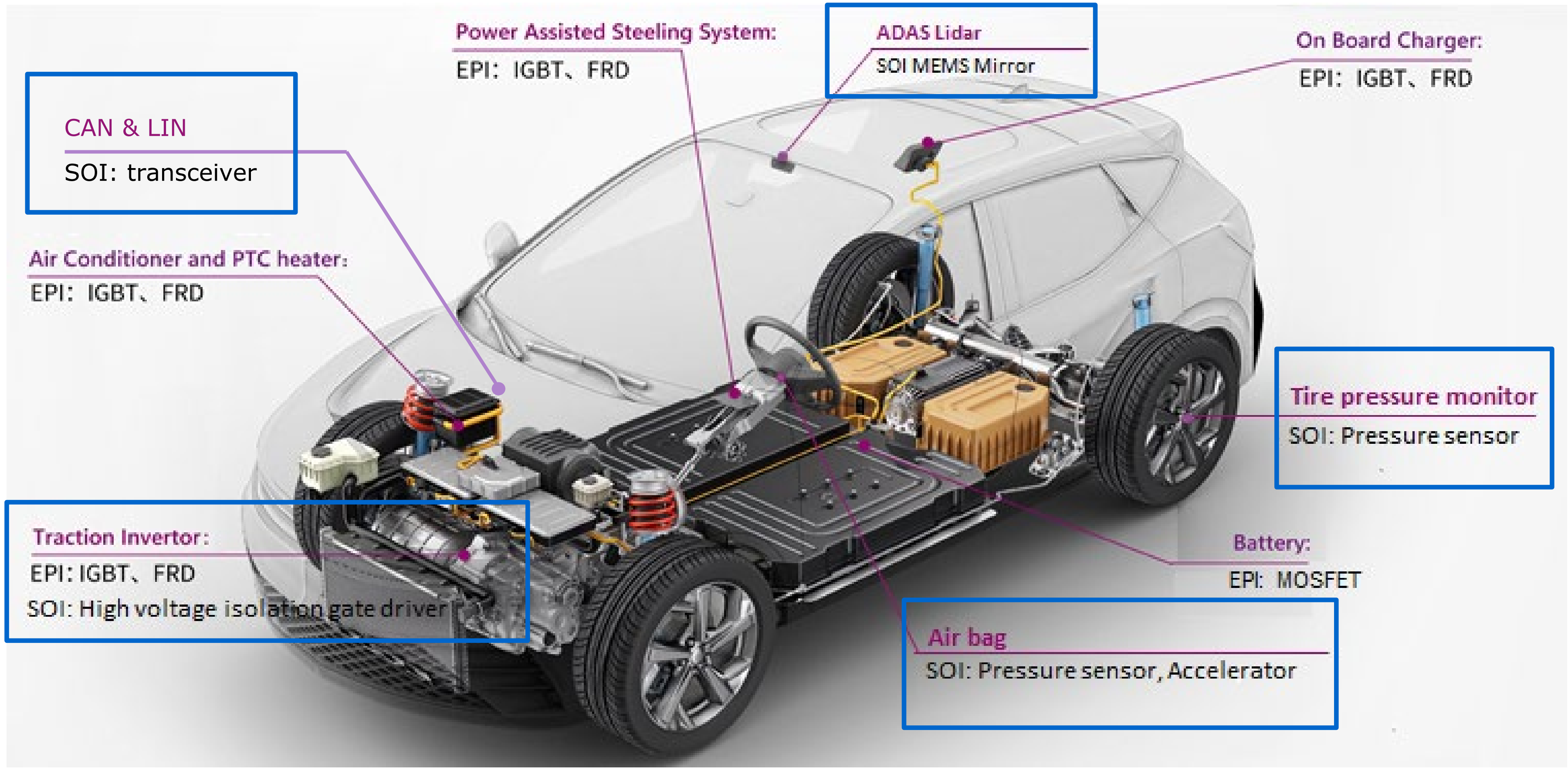
- According to Yole forecast, MEMS market is expected to break through $22 billion in 2027, **CAGR2021-2027 9%**.
- Vehicle MEMS sensor market will exceeded $4.1 billion in 2027, **CAGR2021-2027 10%**, which will be widely used in tire pressure, fuel pressure, air bag pressure, air conditioning pressure, intake manifold pressure and other automotive electronic systems.



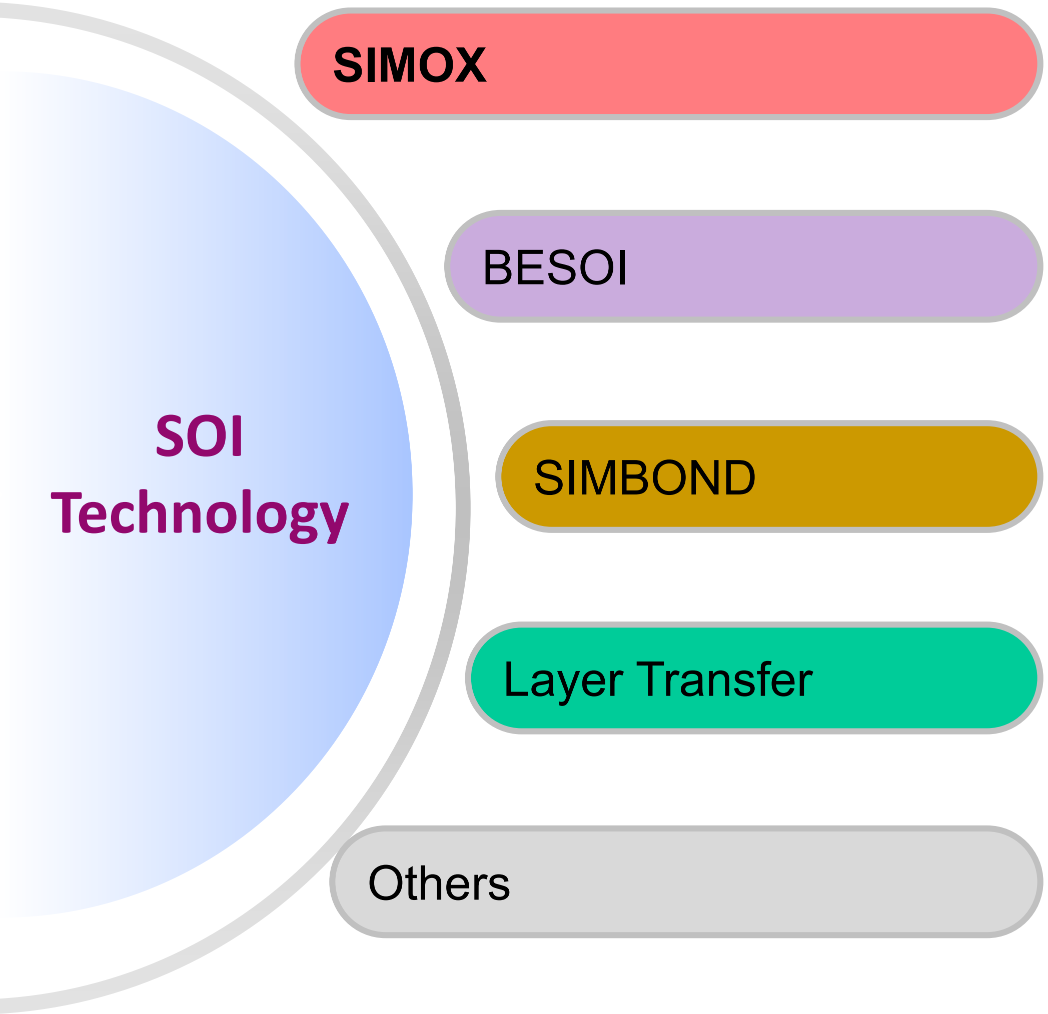
Data Source: Yole

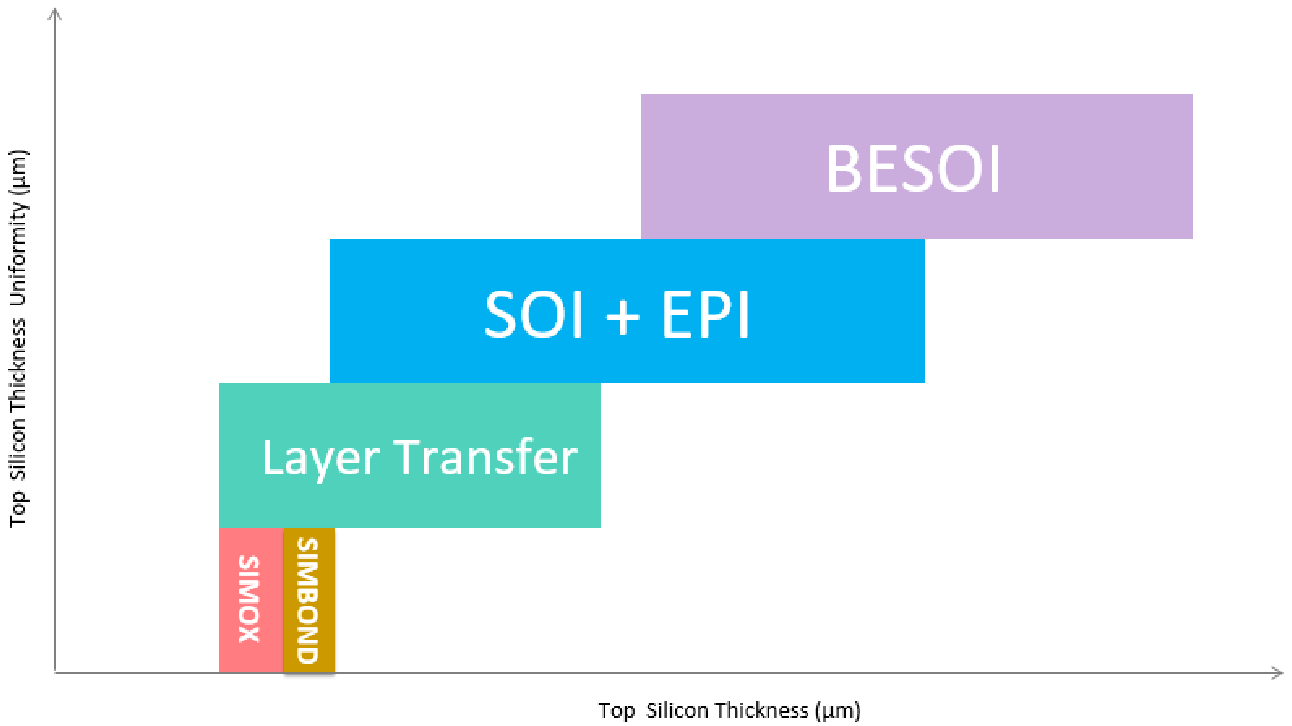
Simgui SOI Product inside Automobile

- **SOI product inside automobile**
- Lidar MEMS Mirror
- High voltage isolation gate driver
- Pressure sensor, Accelerator
- CAN & LIN transceiver



SOI Technology





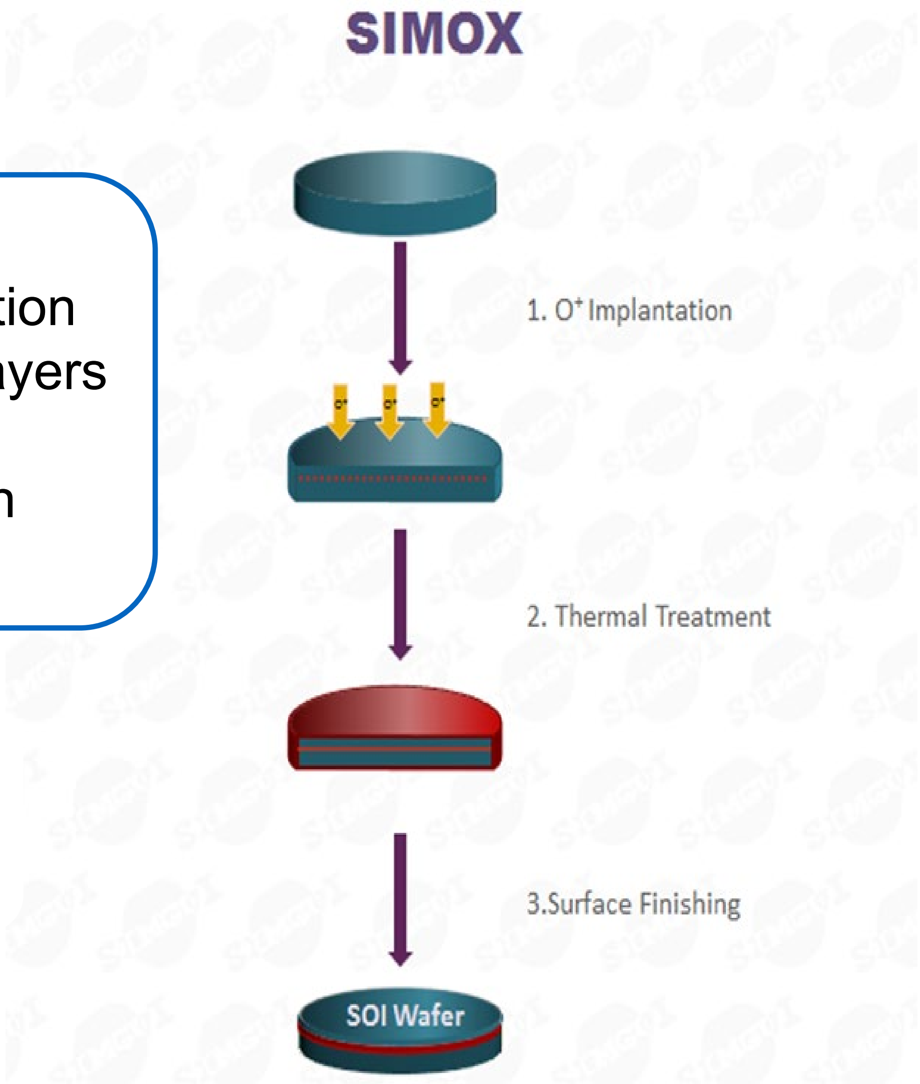
	BESOI	SOI+EPI	Layer Transfer	SIMBOND	SIMOX
Typical SOI thickness	≥ 2 μm	≤ 15 μm	≤ 2 μm	≤ 1μm	≤ 1 μm
Typical BOX thickness	≤ 4 μm	≤ 3 μm	≤ 3 μm	≤ 3 μm	≤0.4 μm

SIMOX Technology

SIMOX：

SIMOX, which stands for Separation by Implantation of Oxygen, creating an insulating layer between the layers of a bulk silicon wafer.

There are two essential stages of the process: ion implantation and annealing.



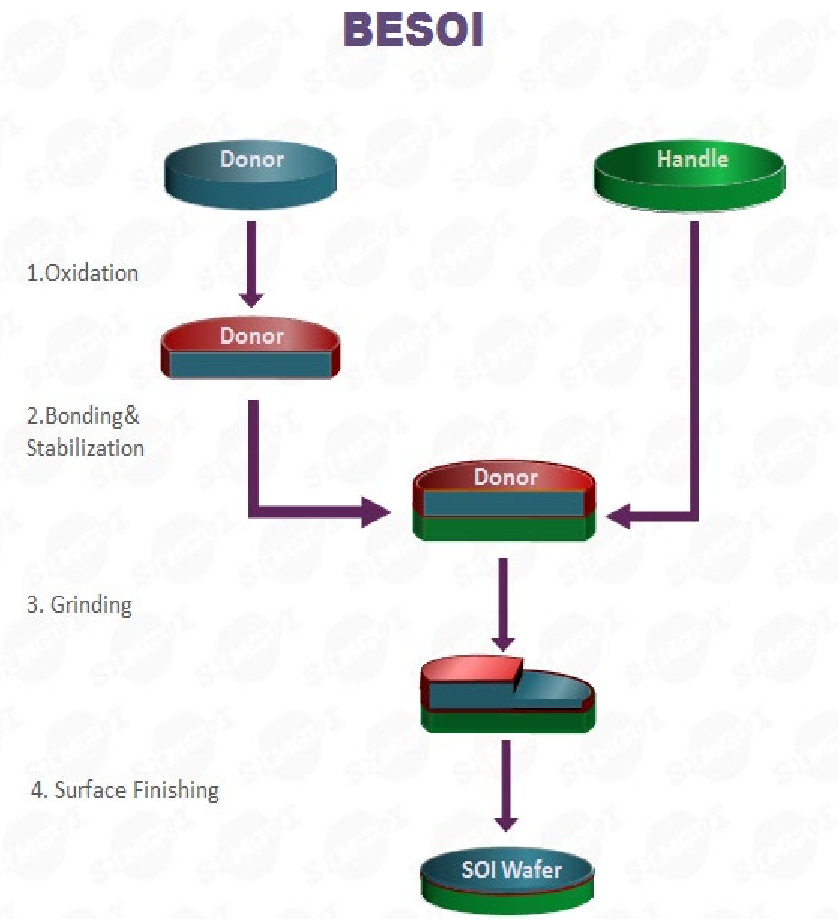
Simox Technical characteristics：

- Good SOI uniformity
- SOI THK can reach thicker by growth epitaxy

BESOI Technology

BESOI ：

By using bonding chemistry between silicon (Si) and silicon dioxide(SiO_2) or between SiO_2 and SiO_2 effectively, two Si wafers are tightly bonded with a SiO_2 layer as an insulator inside the bonded pair. After one side of the Si bulk is thinned down properly with a desired active Si layer thickness, bonded SOI wafers are obtained.



BESOI Technical characteristics ：

- SOI THK normally from 2μm~100μm, or even thicker

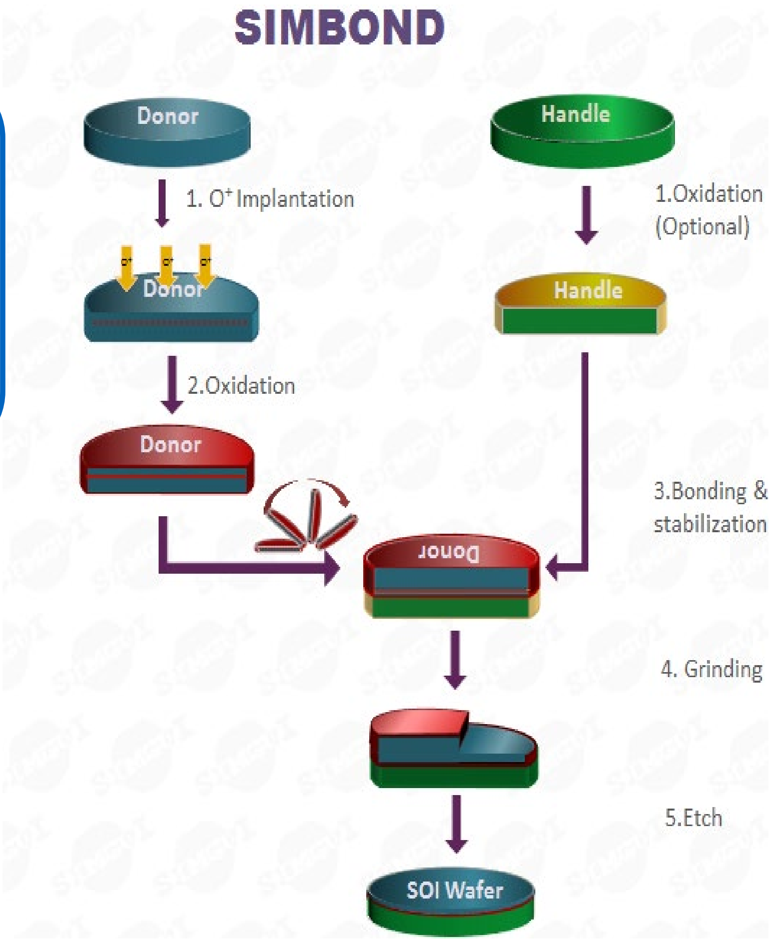
SIMBOND Technology

SIMBOND：

Based on traditional bonding and ion implantation techniques, Simgui and its partners have developed another SOI process, which called “SIMBOND”.

SIMBOND Technical characteristics：

- Good SOI layer uniformity
- SOI THK can reach thicker by growth Epitaxy



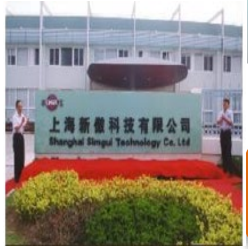
Simgui SOI Technology in 20 Years

2022 — SOI output >40K/M

2015 — Fab3 capacity expansion

2010 — Fab 2&3 establishment

2007 — SIMOX/BESOI/SIMBOND process lines setup and mass production in succession



2001 — Simgui Fab1 Establishment

Summary

- SOI is a major substrate for RF device applications.
- Various SOI technologies can provide different thickness for power applications.
- ADAS Lidar MEMS SOI technology is mature and can support xEV and intelligence car growth in China market.
- MEMS SOI has been widely used in tire pressure, fuel pressure, air bag pressure, air conditioning pressure to support China automotive industrial.
- Simgui has advanced SOI technologies, mass production capability & capacity, has become an important supplier in the world.