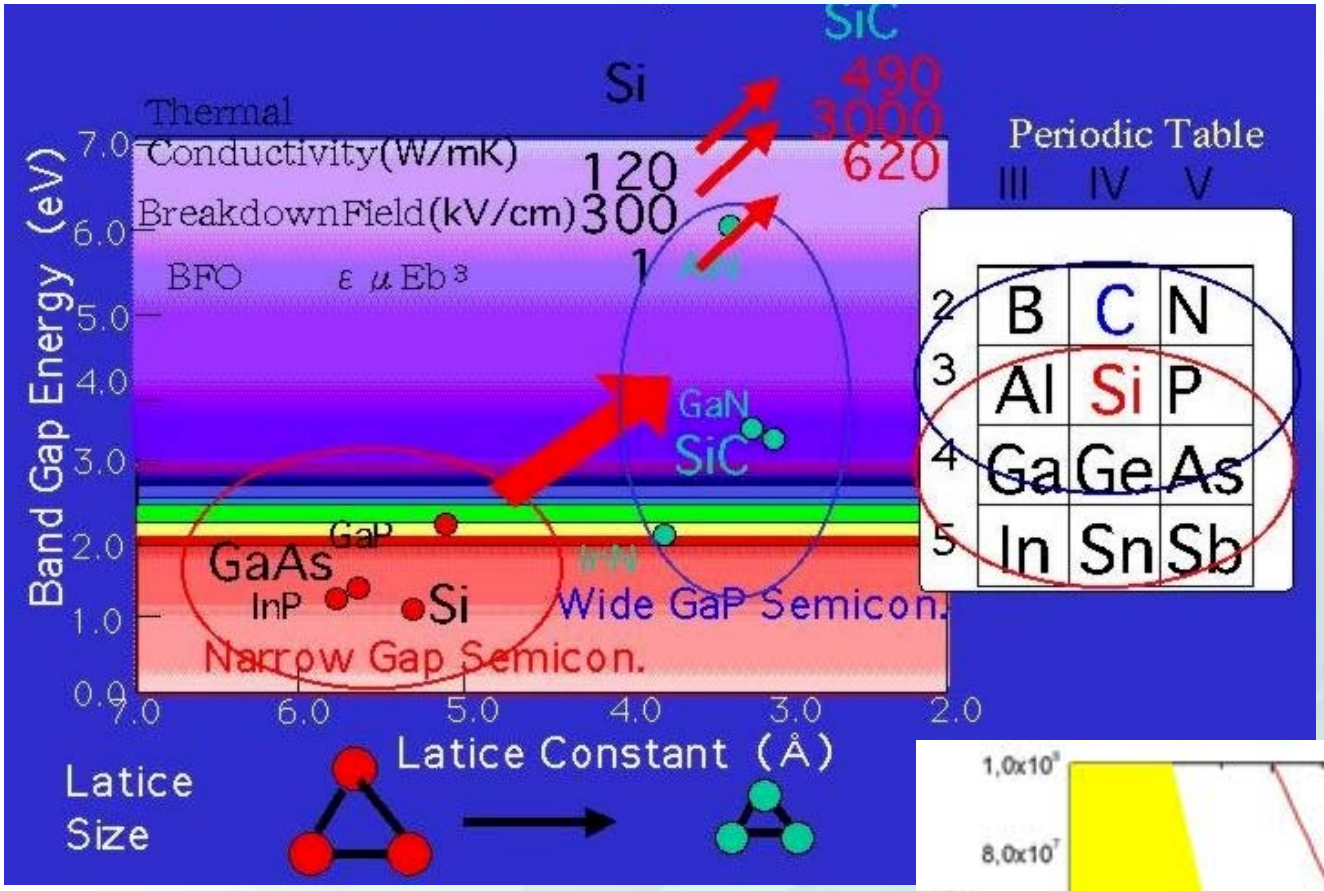
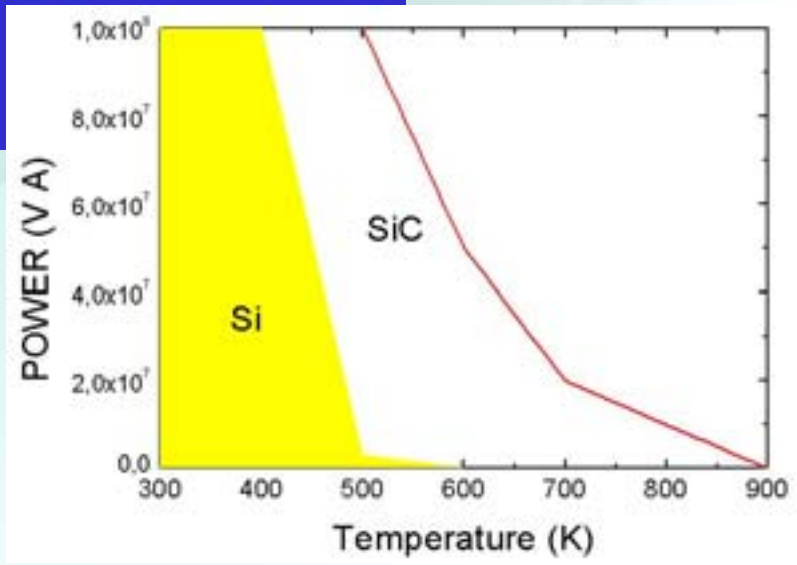
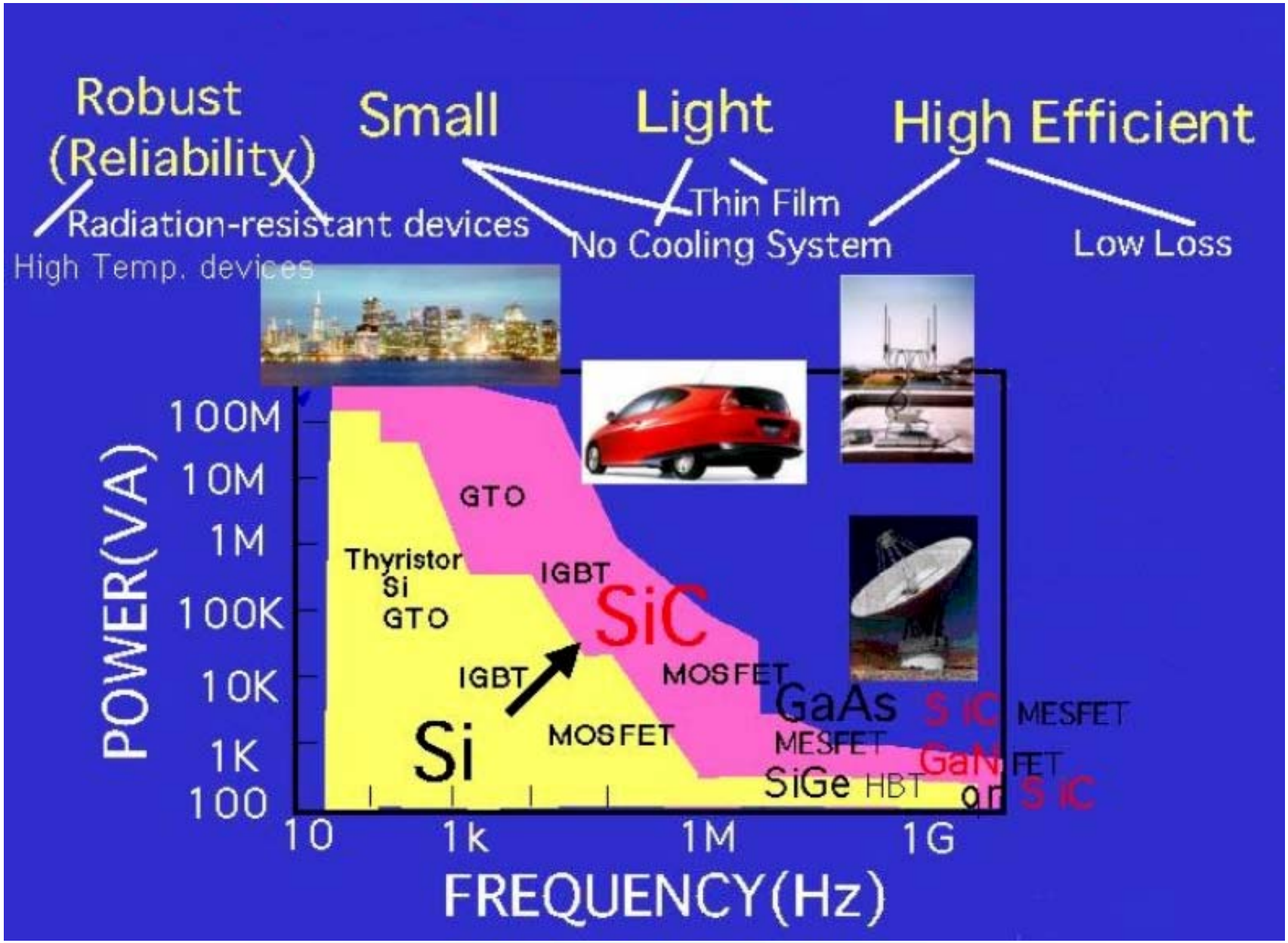
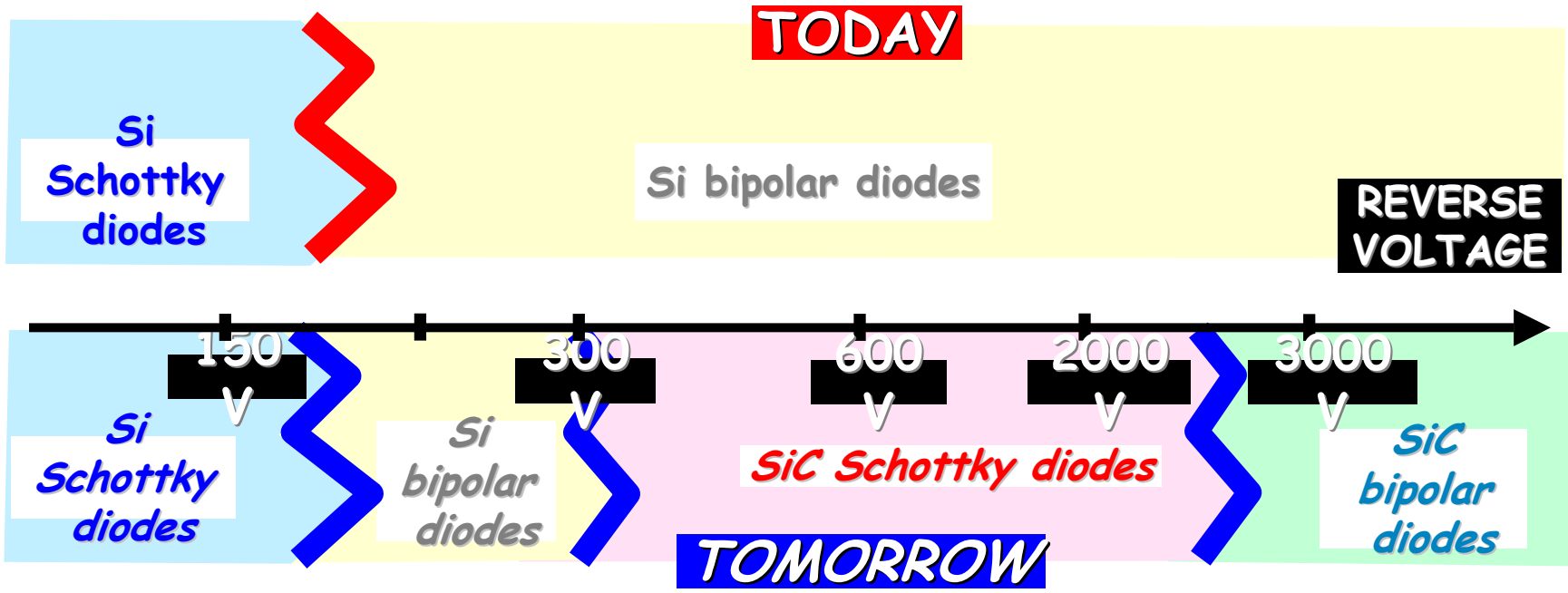
Devices and sensors
for high temperature applications


SiC
Si
Thermal
Conductivity(W/mK)
120
490
3000
620
Breakdown Field(kV/cm)
300
1
BFO
ε μ Eb³
GaN
SiC
GaP
GaAs
InP
Si
InN
Wide GaP Semicon.
Narrow Gap Semicon.
Band Gap Energy (eV)
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
Latice Constant (Å)
Latice
Size
Periodic Table
III IV V
2 B C N
3 Al Si P
4 Ga Ge As
5 In Sn Sb


POWER (V A)
1,0x10⁸
8,0x10⁷
6,0x10⁷
4,0x10⁷
2,0x10⁷
0,0
SiC
Si
300
400
500
600
700
800
900
Temperature (K)


Robust
(Reliability)
Small
Light
High Efficient
Radiation-resistant devices
High Temp. devices
Thin Film
No Cooling System
Low Loss
POWER(VA)
100M
10M
1M
100K
10K
1K
100
GTO
Thyristor
Si
GTO
IGBT
SiC
IGBT
MOSFET
Si
MOSFET
GaAs
MESFET
SiGe HBT
SiC
MESFET
GaN FET
or SiC
10
1k
1M
1G
FREQUENCY(Hz)

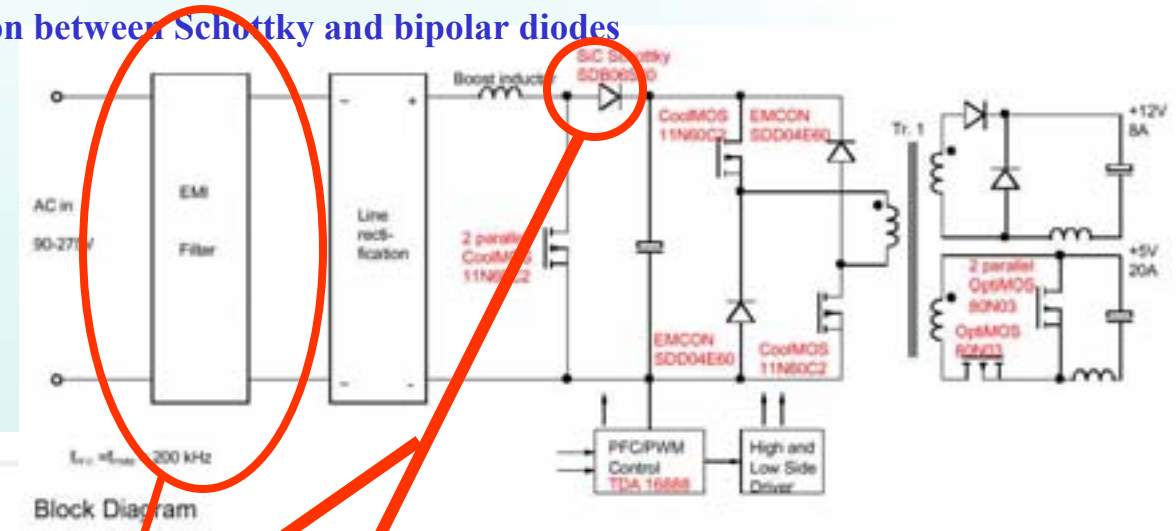

TODAY
Si Schottky diodes
Si bipolar diodes
REVERSE VOLTAGE
150 V
300 V
600 V
2000 V
3000 V
Si Schottky diodes
Si bipolar diodes
SiC Schottky diodes
SiC bipolar diodes
TOMORROW

The future world

SENSORS AND POWER COMPONENTS

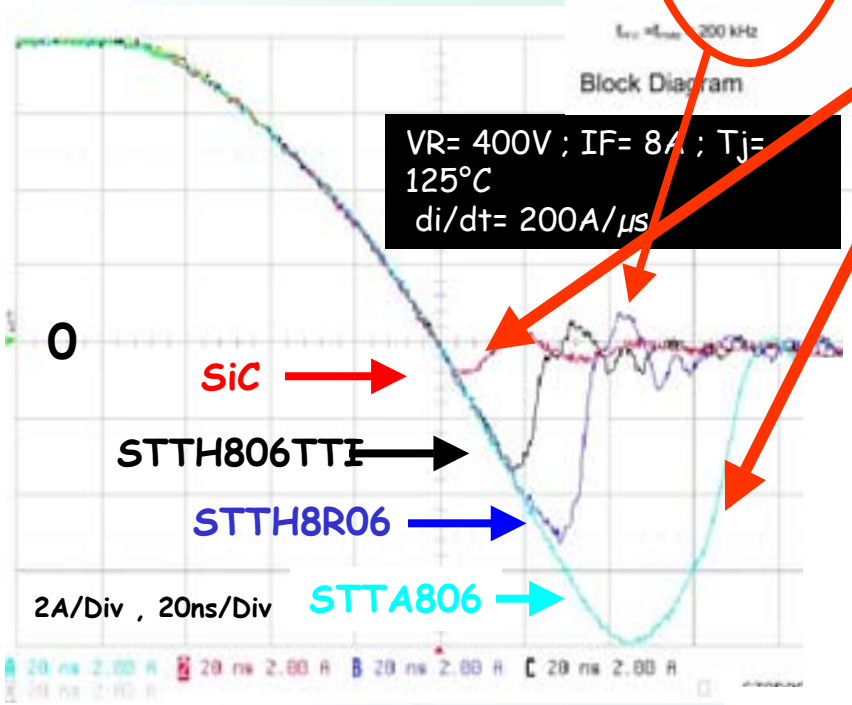
Diodes

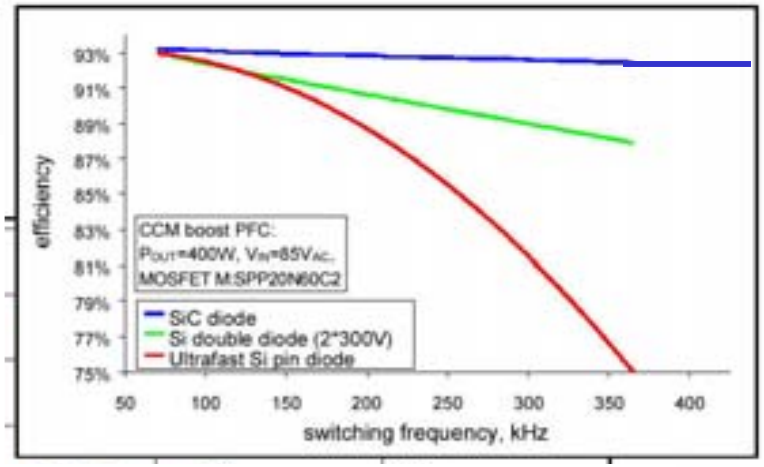
Diode recovery: comparison between Schottky and bipolar diodes



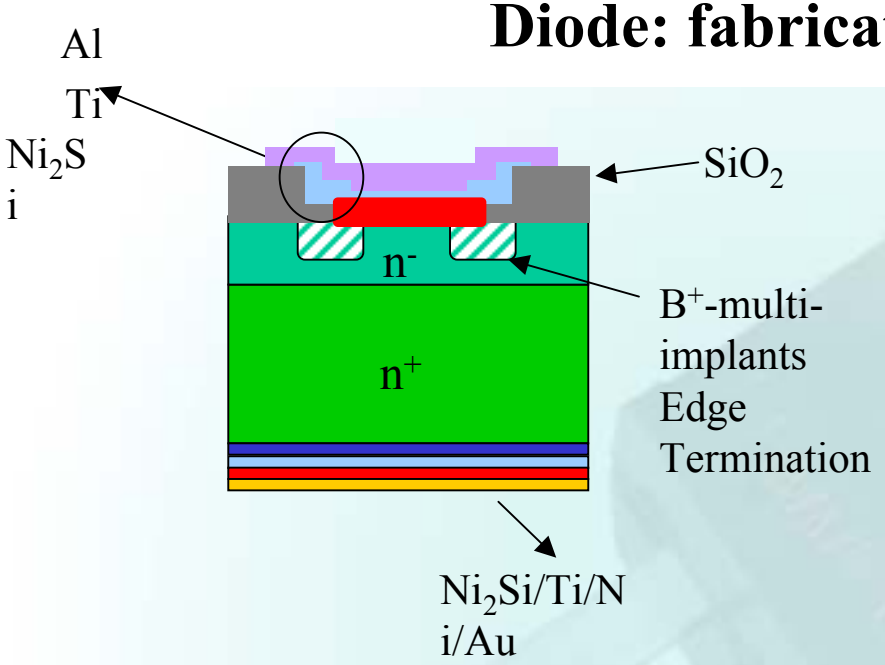
Block Diagram

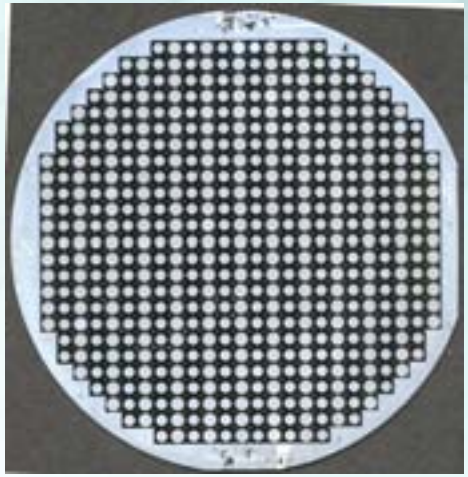
Turn-OFF COMPARISON

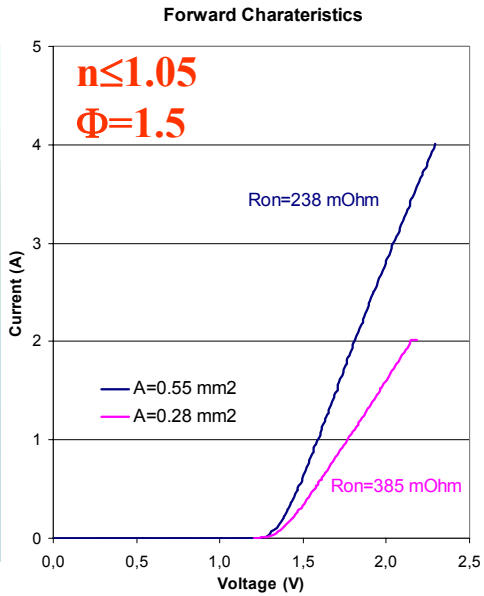


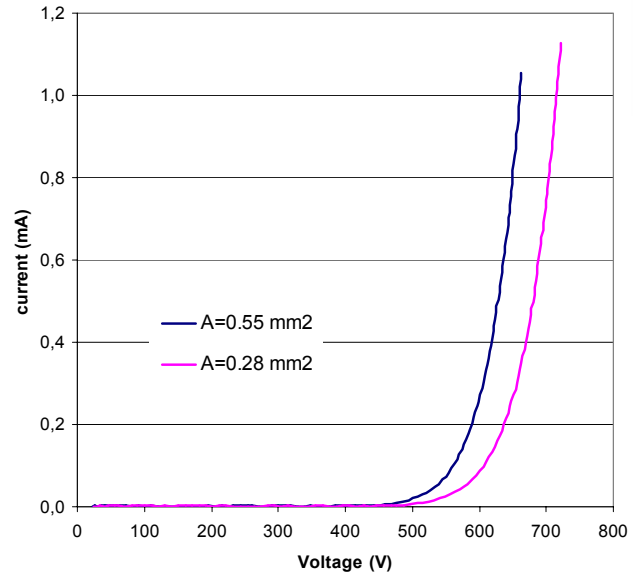


Diode: fabrication

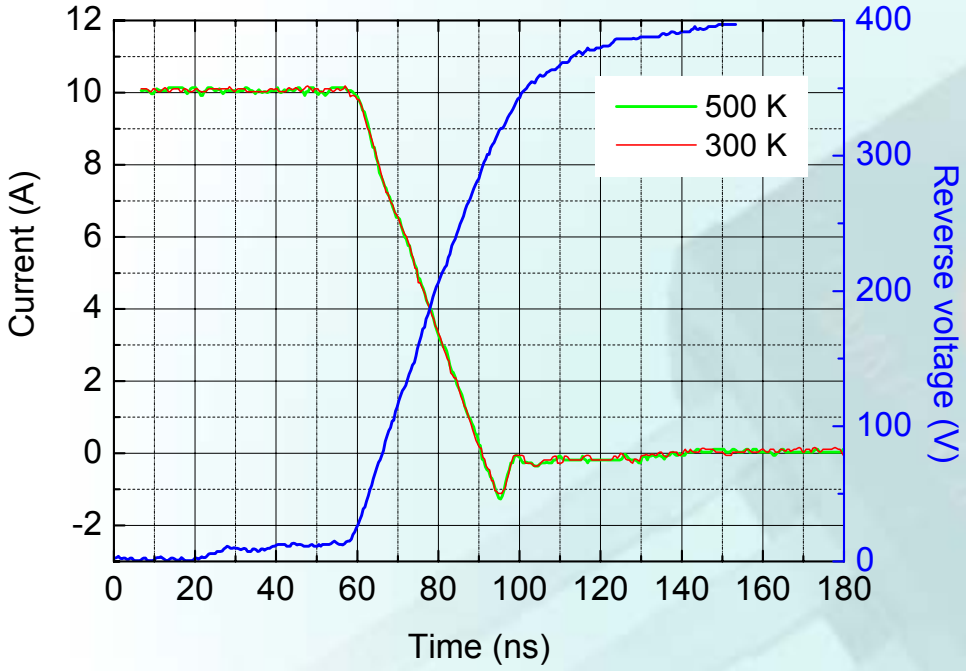


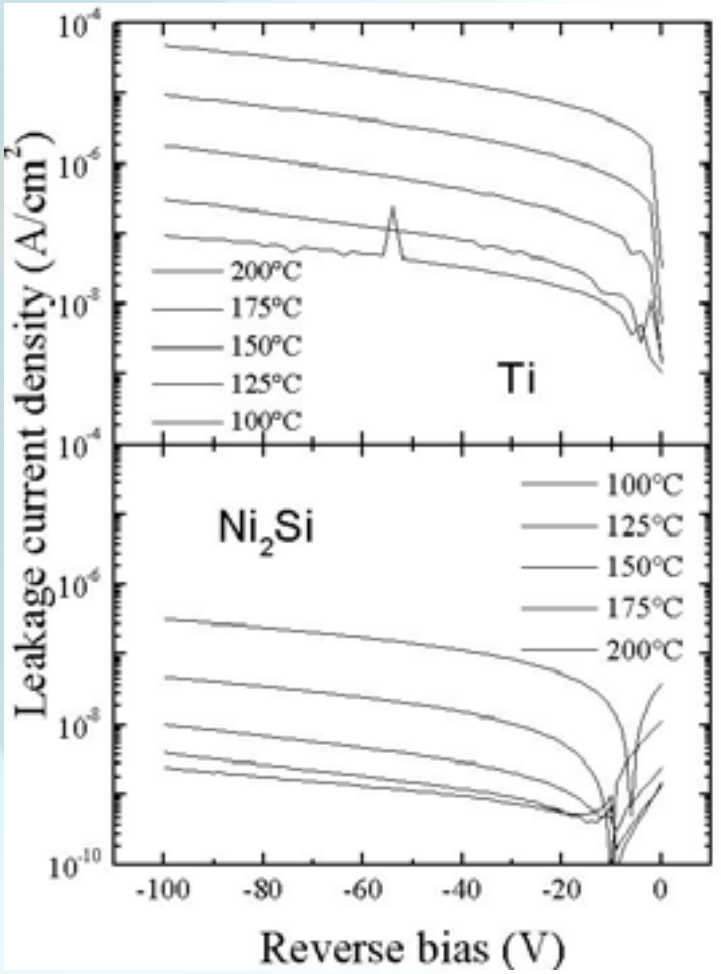






Diode: temperature behaviour

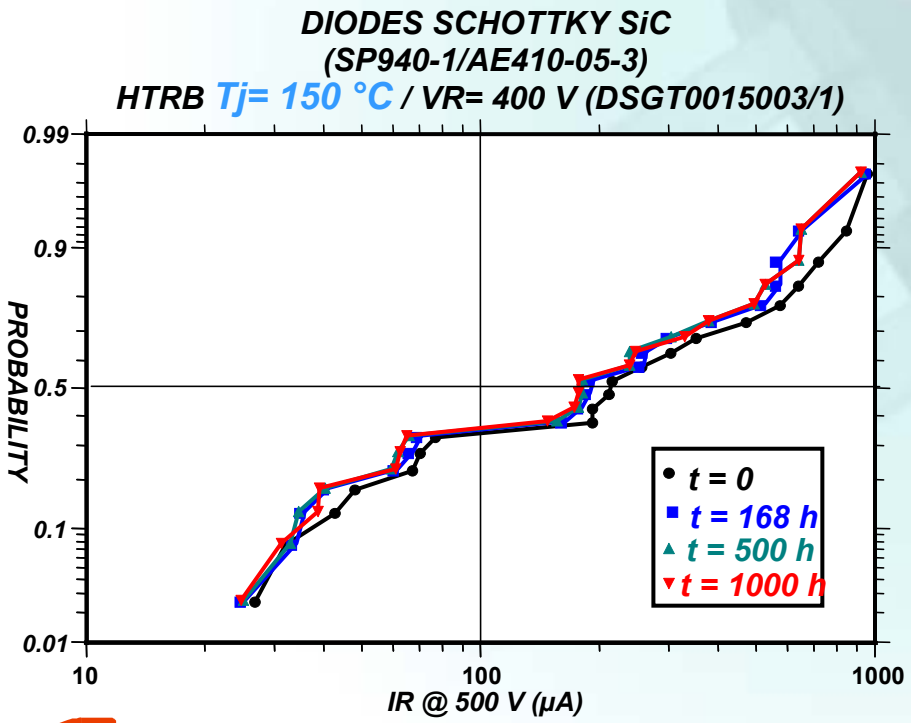


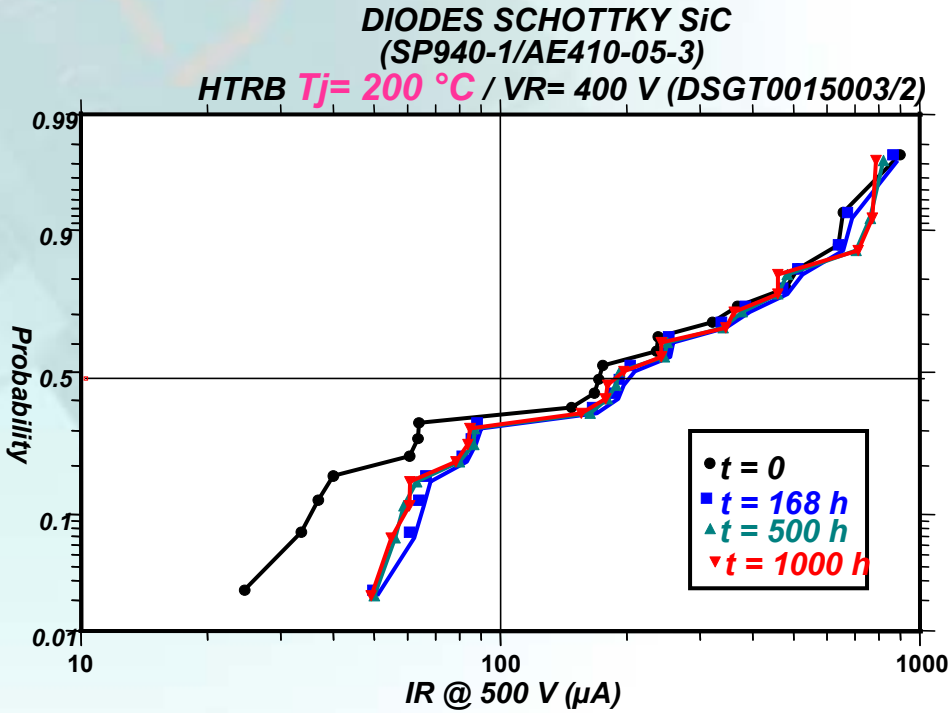


LOW POWER DISSIPATION

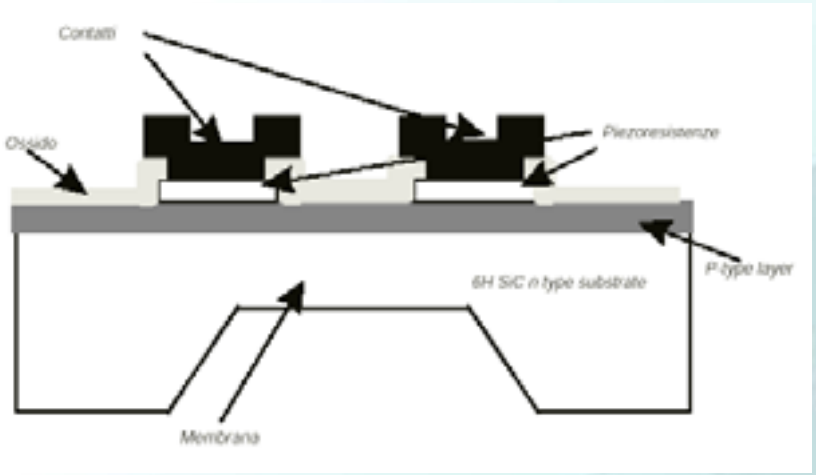
SiC Schottky diodes: reliability trials

HTRB: High Temperature Reverse Bias



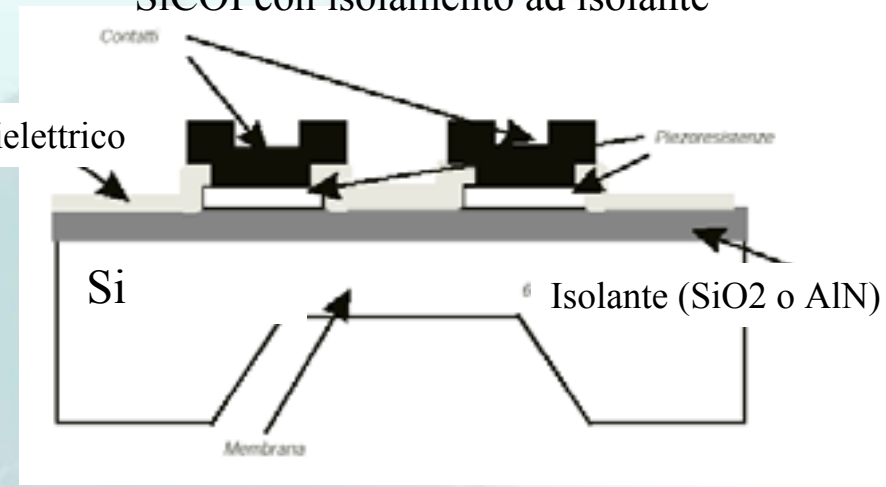


Pressure sensors: fabrication

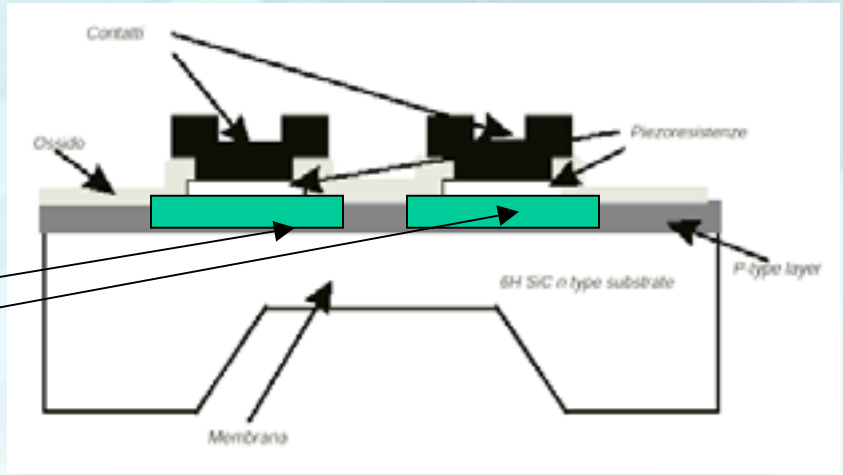


SiCOI con isolamento ad isolante

dielettrico

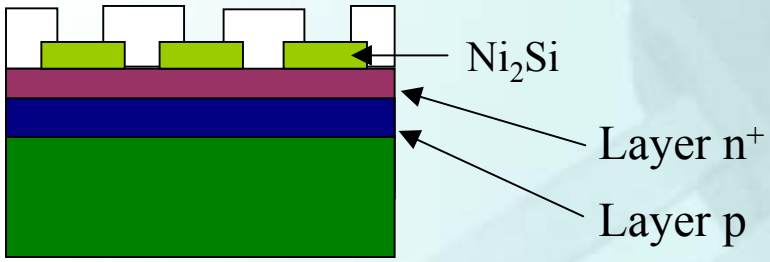


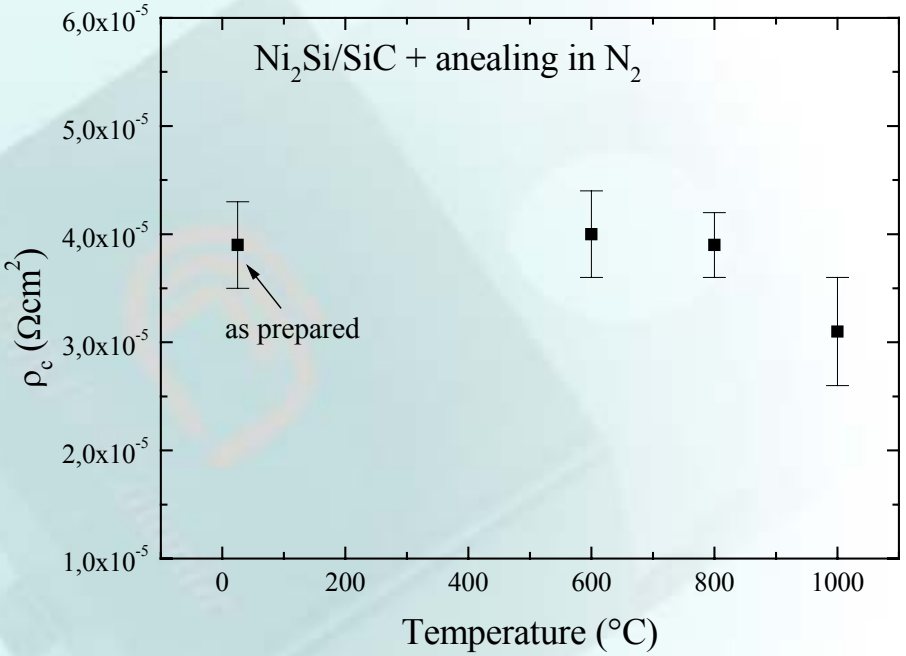
Buried oxide

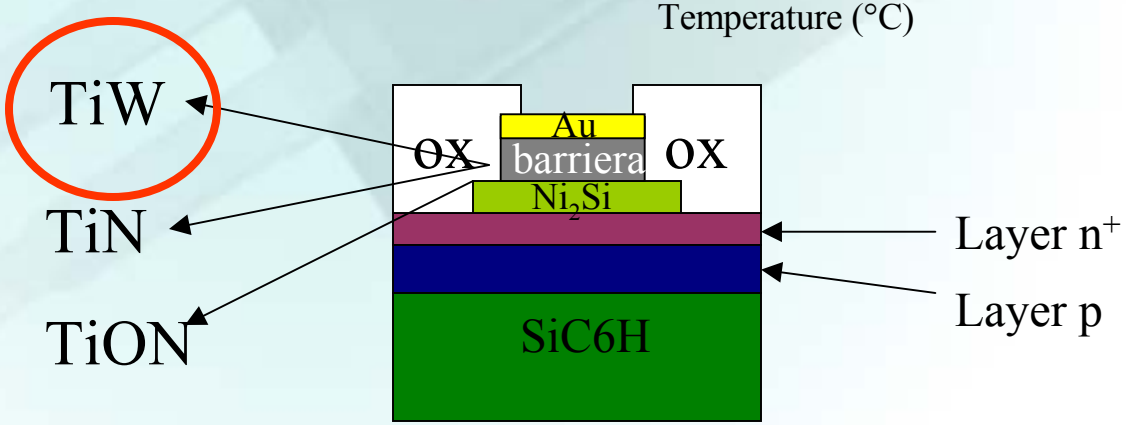


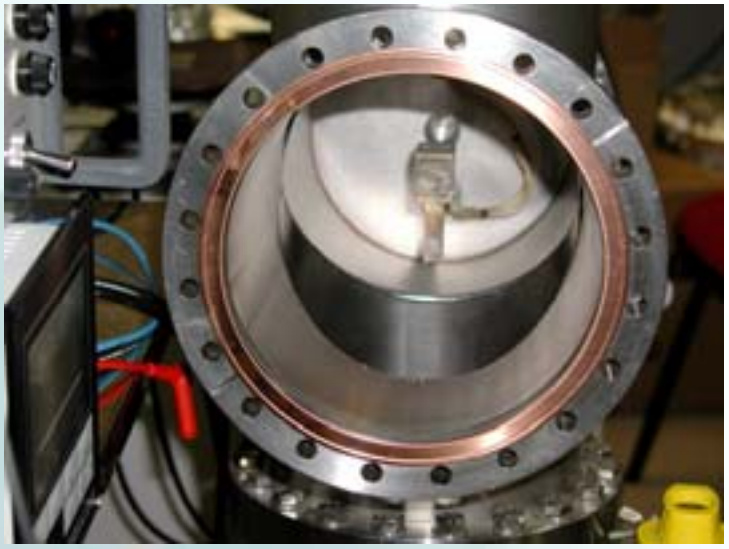
Common problem: metallisations

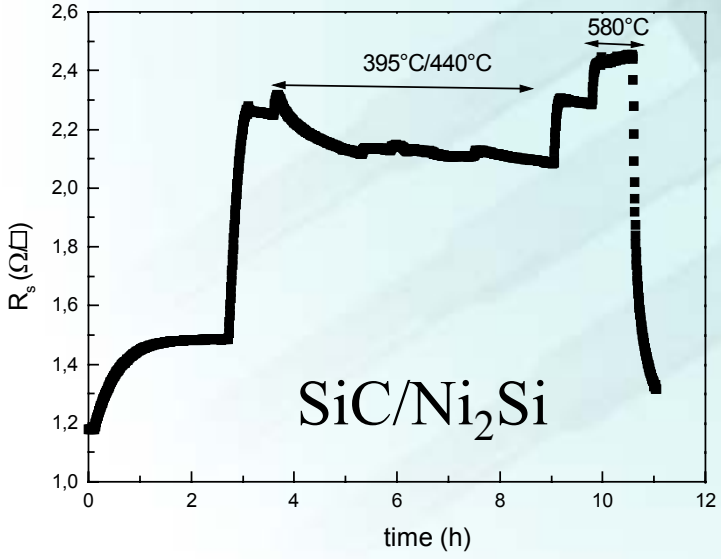
Thermal stability
up to 1000°C in N_2

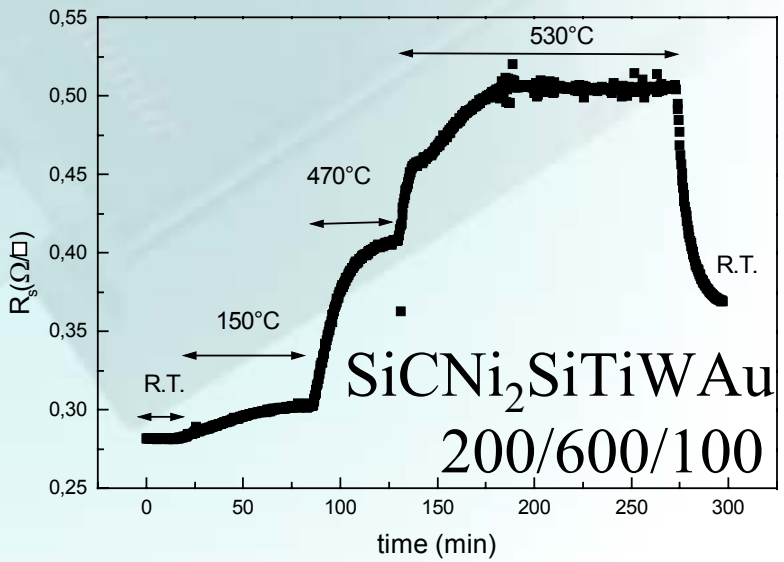









580°C
395°C/440°C
SiC/Ni2Si
Rs (Ω/□)
time (h)
2,6
2,4
2,2
2,0
1,8
1,6
1,4
1,2
1,0
0
2
4
6
8
10
12


530°C
470°C
150°C
R.T.
R.T.
SiCNi2SiTiWAu
200/600/100
Rs(Ω/□)
time (min)
0,55
0,50
0,45
0,40
0,35
0,30
0,25
0
50
100
150
200
250
300

Conclusion

- High temperature applications require low leakage current for low power dissipation.
- Diodes working at high temperatures have been designed, fabricated and characterized demonstrating low leakage current up to 200°C
- Sensors require even higher working temperature
- Au/TiW/Ni_2Si metallisation stack has been demonstrated for applications up to about 400°C