

Wafer Supplier Aspects of FD-SOI and RF-SOI

SOI Engineering Section, SOI Production Department, Isobe Plant
Shin-Etsu Handotai Co., Ltd.

Digital Communication World is Expanding Drastically

Mobile Technology



high speed, long battery life
worldwide use (2G, 3G, 4GLTE,5G)

Internet of Things (M2M)



Cloud Technology

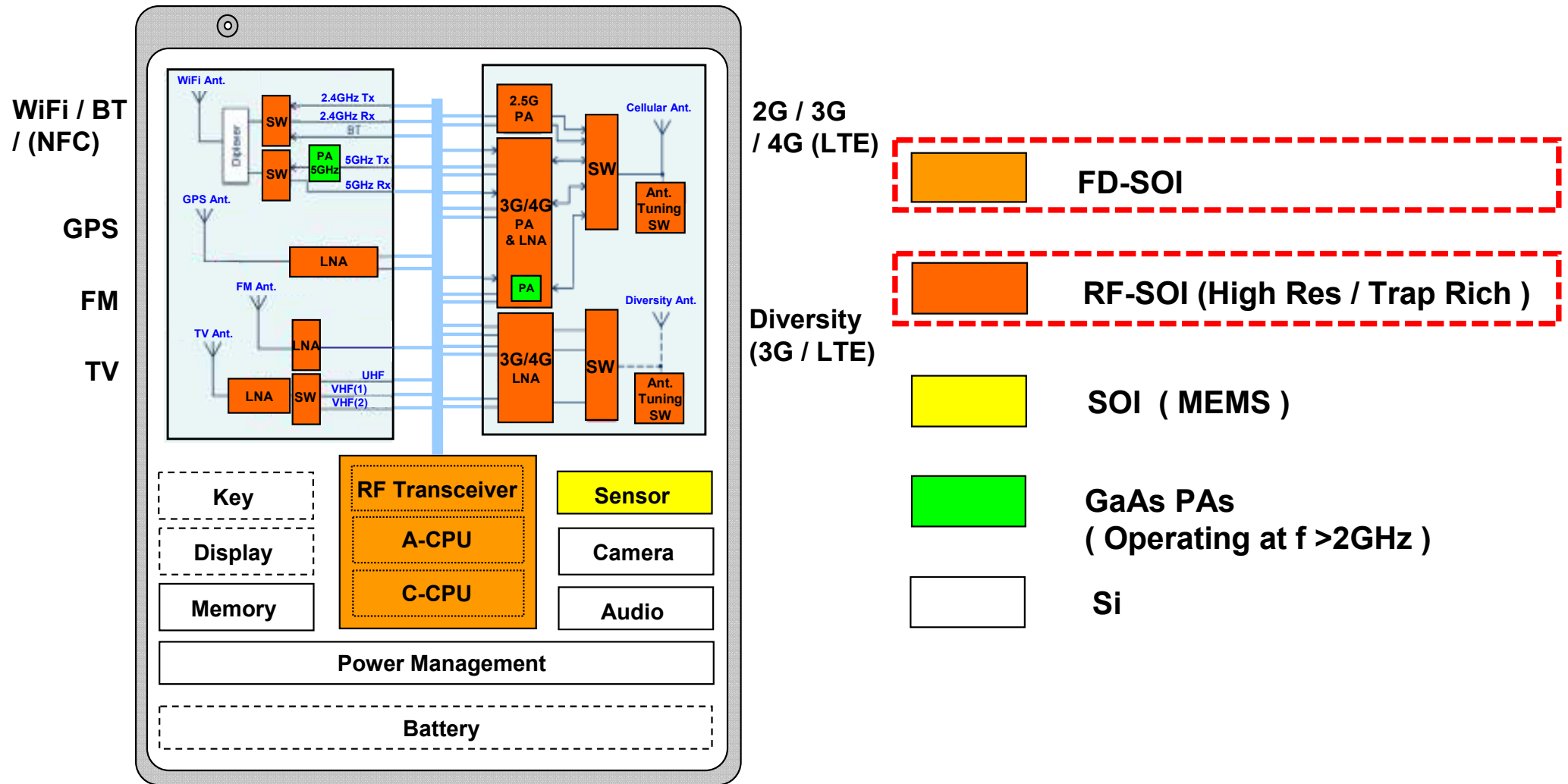
huge data traffic
big data center



SOI technology is attractive!

- **FD-SOI devices** for SOC application
- **RF-SOI devices** for RF application

SOI Wafers in a Mobile Handset



Recent Advanced SOI

Logic Application

FD-SOI
SOI thk +/- 0.5nm

SOI -FinFET

PD SOI
SOI thk +/- 3.5nm

2002

Thin-SOI production start

RF Application

RF-SOI
Handle : HR, w/poly

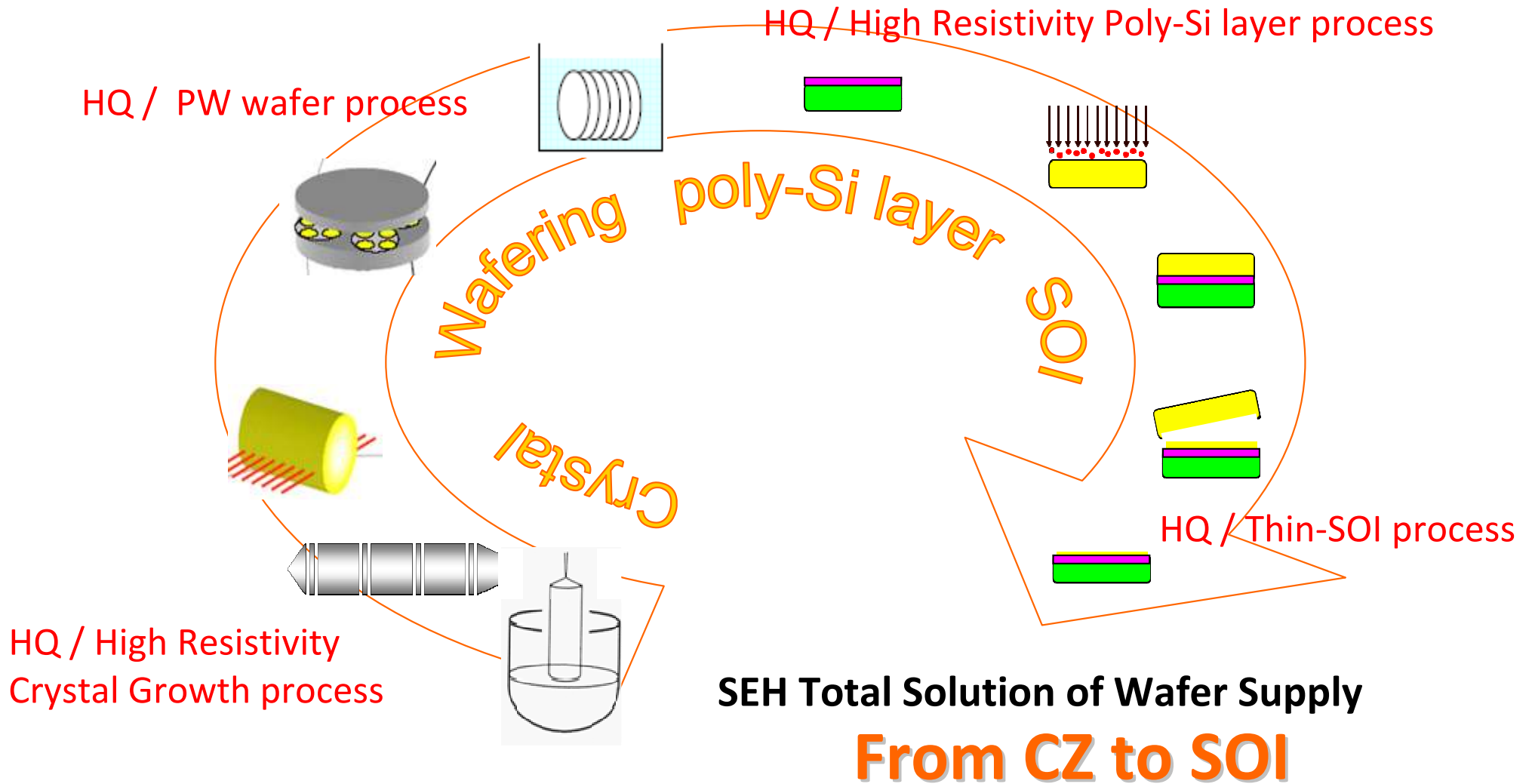
Photonics Application

SOI
BOX thk >1000nm

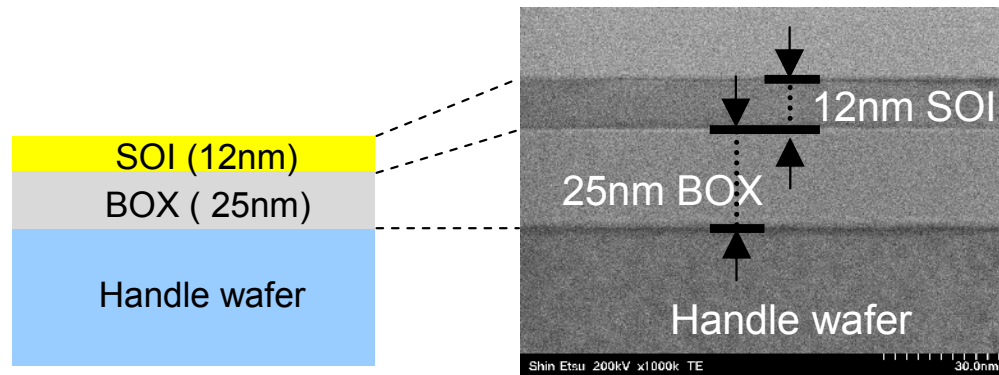
CIS / MEMS

Epi on SOI
SOI thk > 1000nm

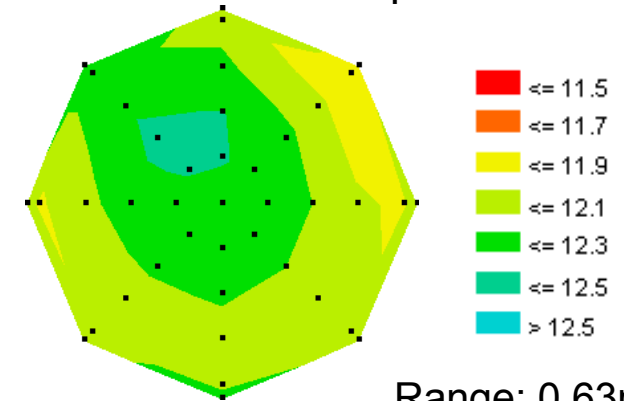
SOI Technology for FD-SOI and RF-SOI



SOI Thickness Uniformity of FD-SOI

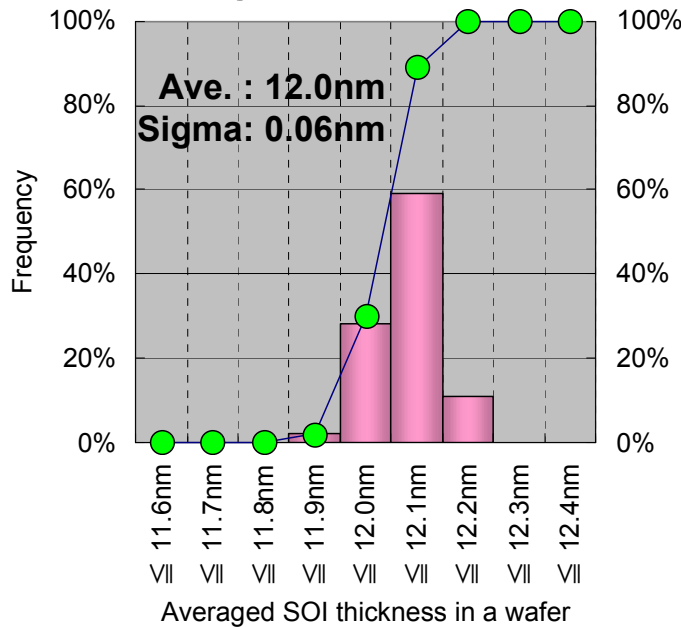


SOI Thickness Map

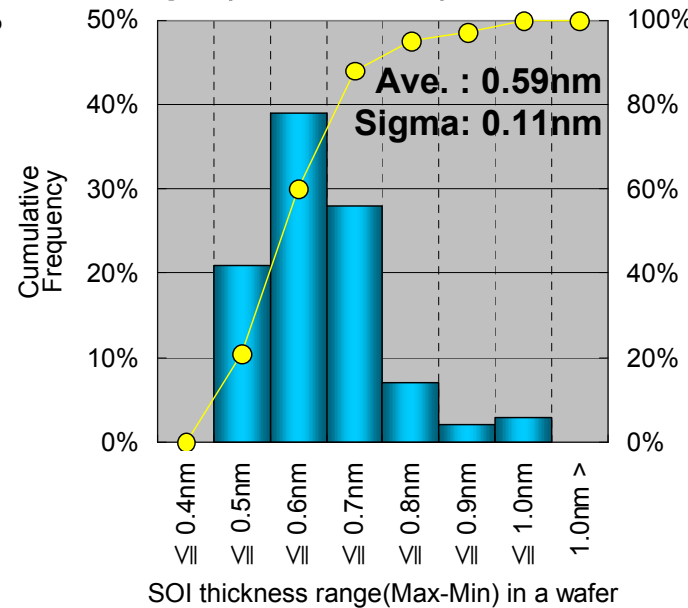


Range: 0.63nm

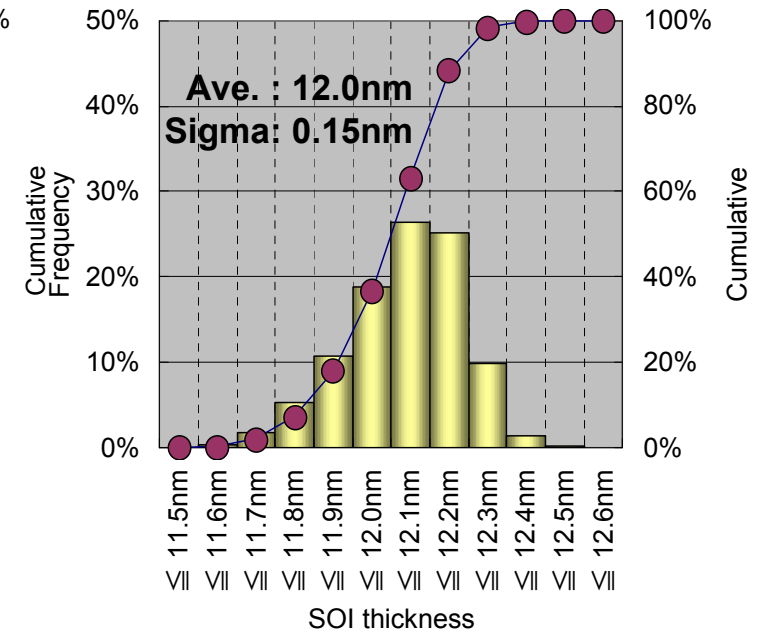
Average SOI thickness



Range(Max-Min) in a wafer

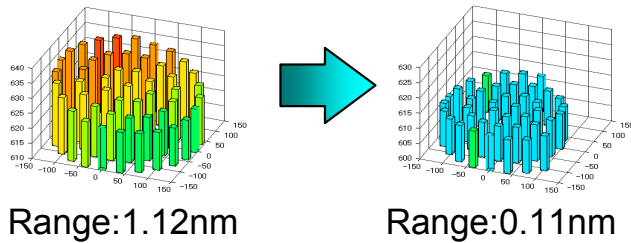


All points

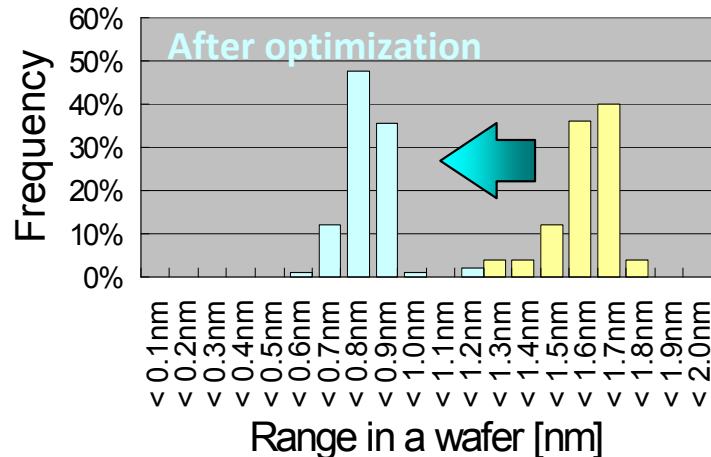


Improvement of SOI Thickness for FD-SOI

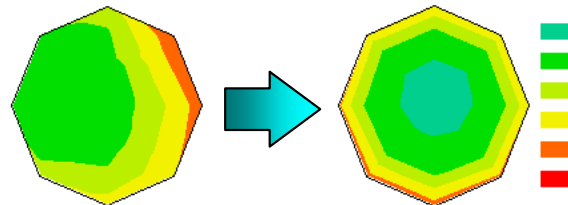
Optimization of oxidation condition



Optimization of implantation & Splitting condition



Optimization of oxidation condition



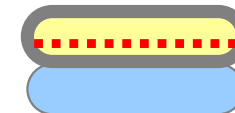
Oxidation

Donor wafer

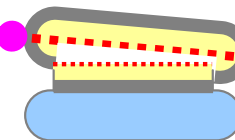
Implantation



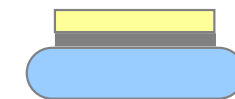
Handle wafer



Bonding

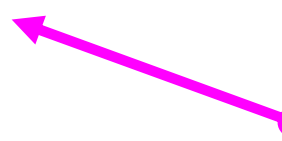


Splitting

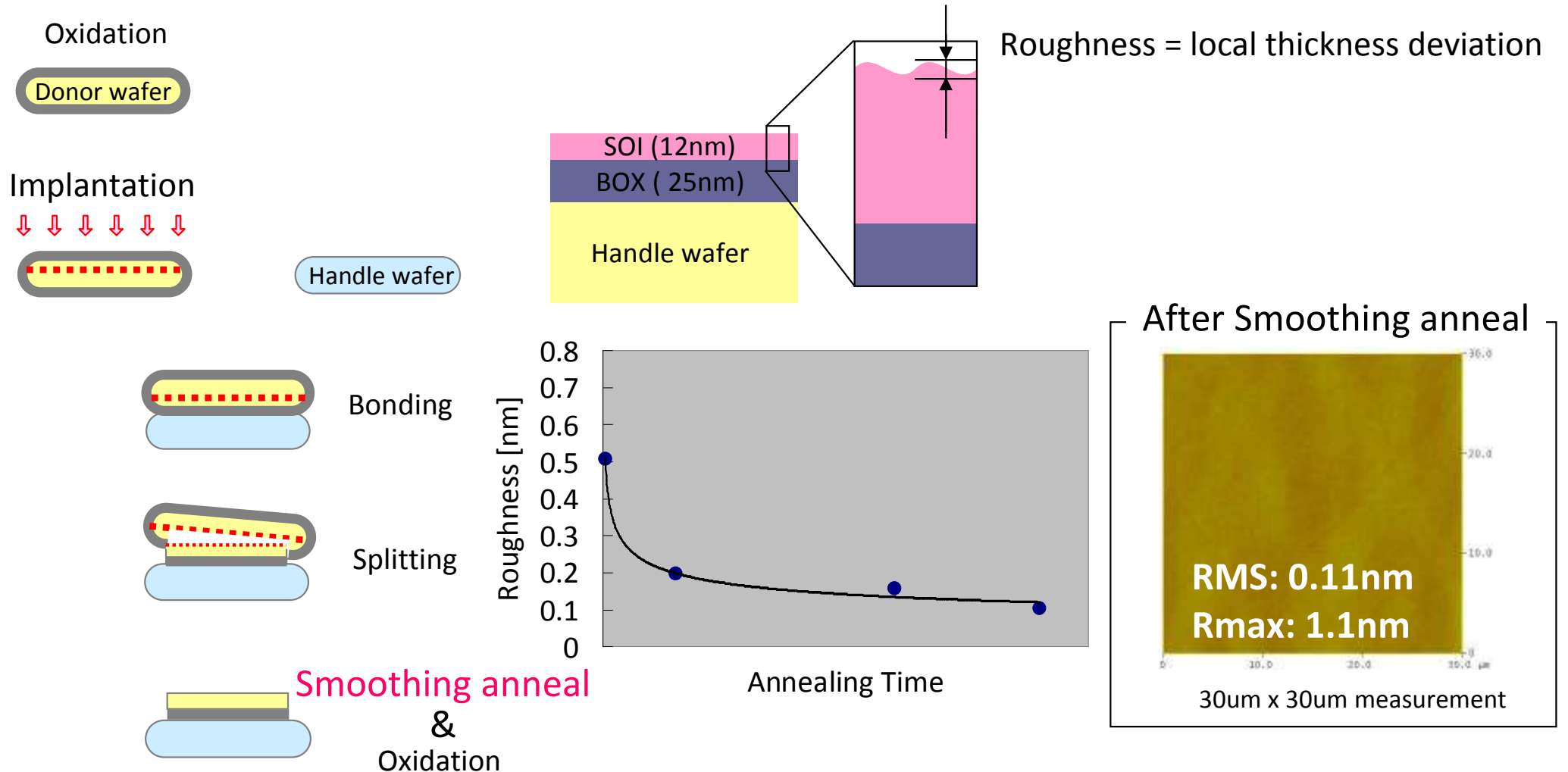


Smoothing
anneal
&
Oxidation

SOI
thickness
uniformity

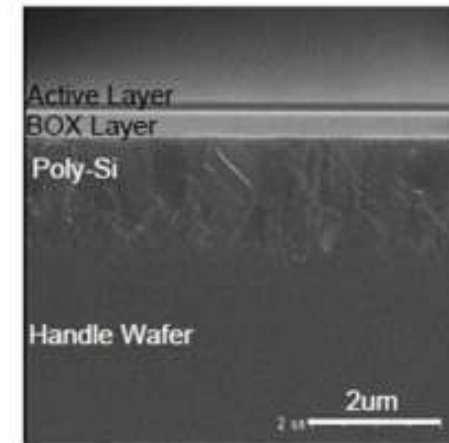
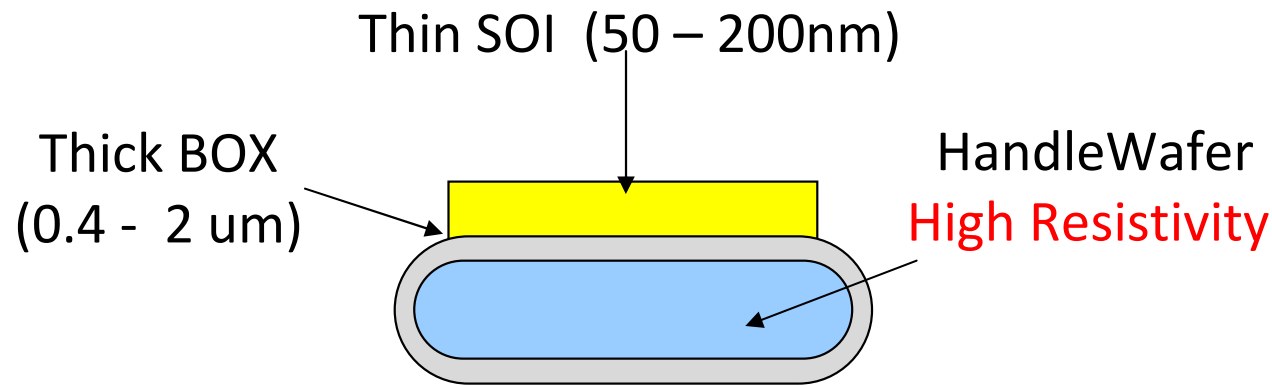


Surface Roughness



AFM roughness is very close to ideal region. (RMS<0.1nm)

SOI Wafer for RF Application



1) **Stable Resistivity** suppress the thermal donor formation

Interstitial Oxygen become a donor by low temperature heat treatment.

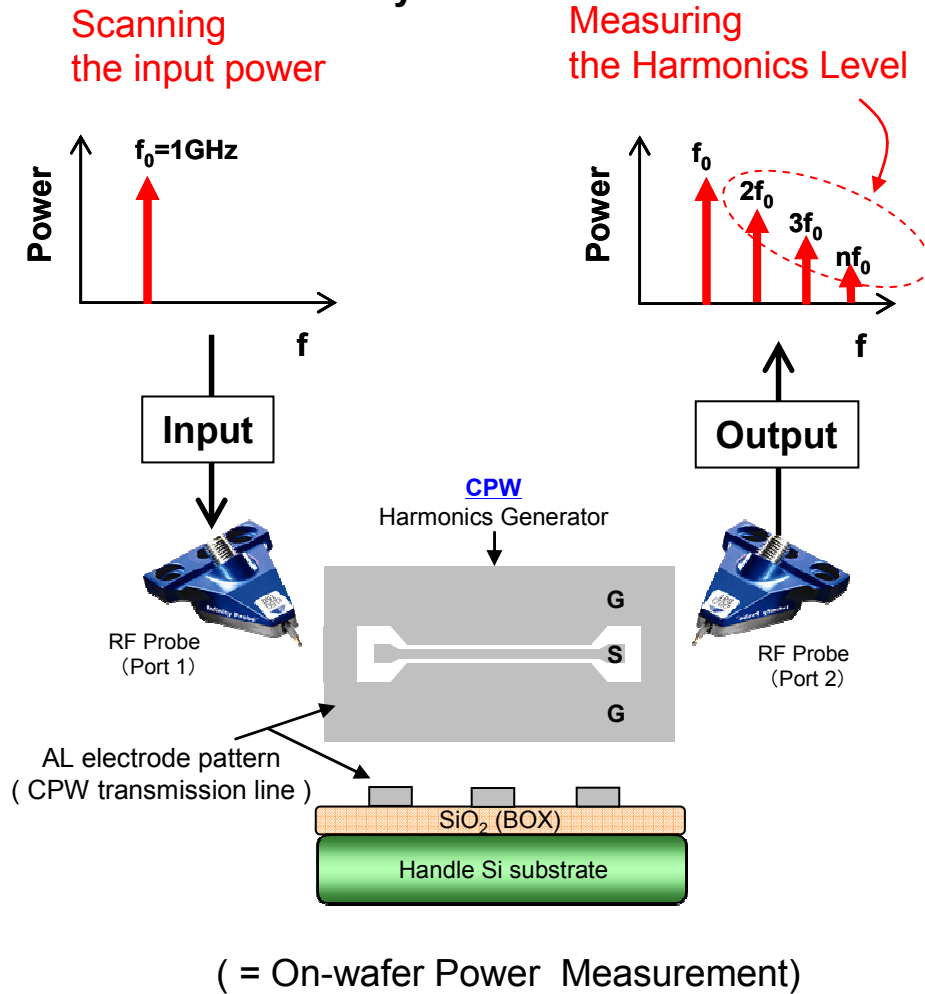
→ High quality CZ crystal (high resistivity, extra low impurity, extra low O_i) was developed.

2) **Superior RF Characteristics** suppress PSC (parasitic surface conduction)

→ Trap Rich SOI technology (SOI with poly-Si layer)

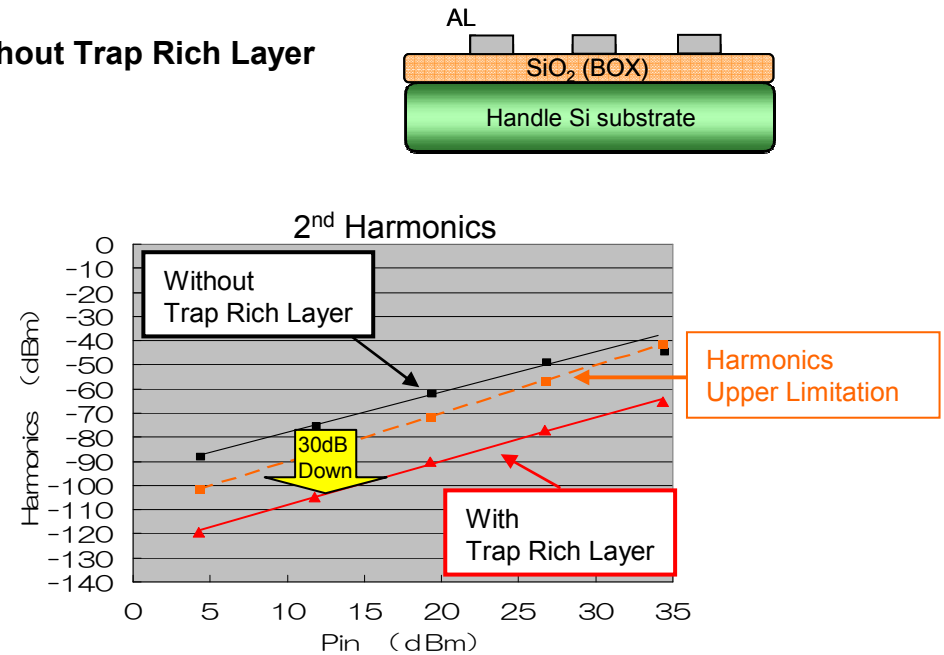
Harmonics Measurement

< System >

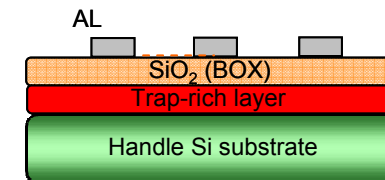


< Measured Harmonics in SEH >

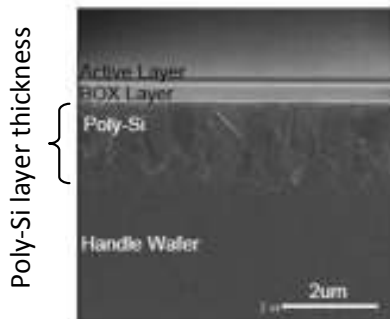
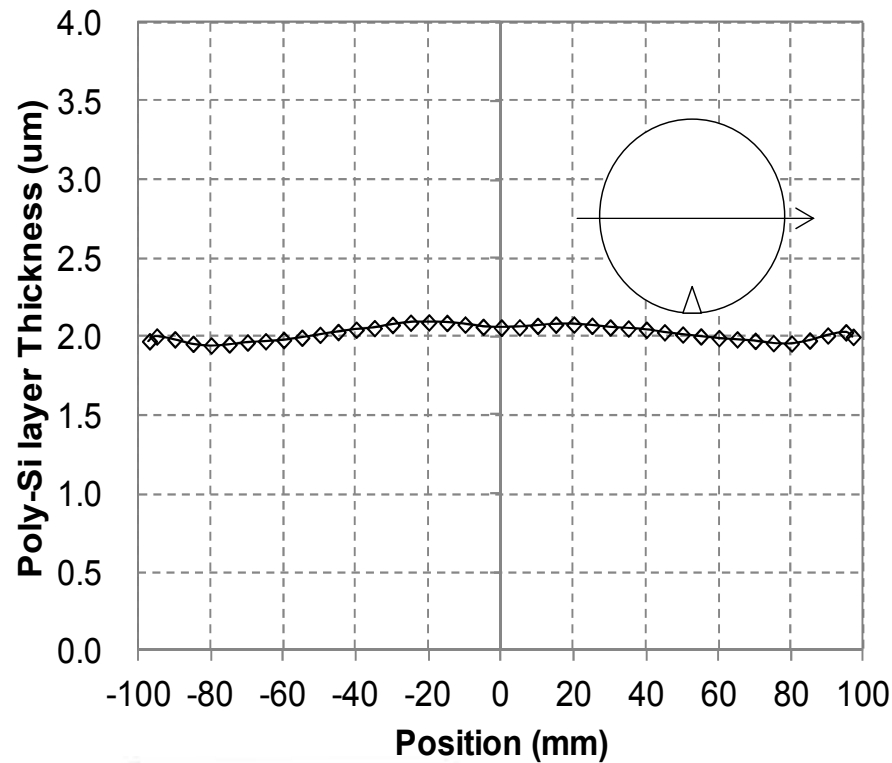
Without Trap Rich Layer



With Trap Rich Layer



Thickness Uniformity of Poly-Si Layer



RF Characteristics Uniformity within a Wafer

