

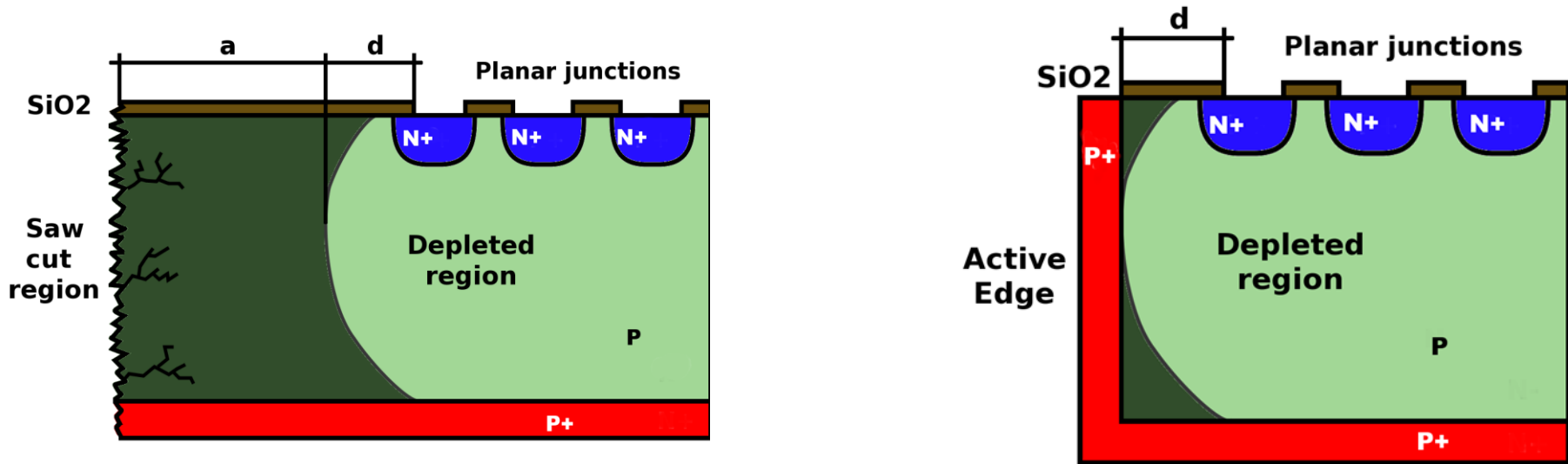
# Edgless Technology: a “personal” point of view

*Maurizio Boscardin*  
*boscardi@fbk.eu*



Fondazione Bruno Kessler  
**Centre for Materials and Microsystems**

# Planar Detector with Active Edge



## Define a «sequence»

1. Realization of the devices (on wafer)
2. UBM deposition
3. DIE separation & thinning
4. Bump Bonding

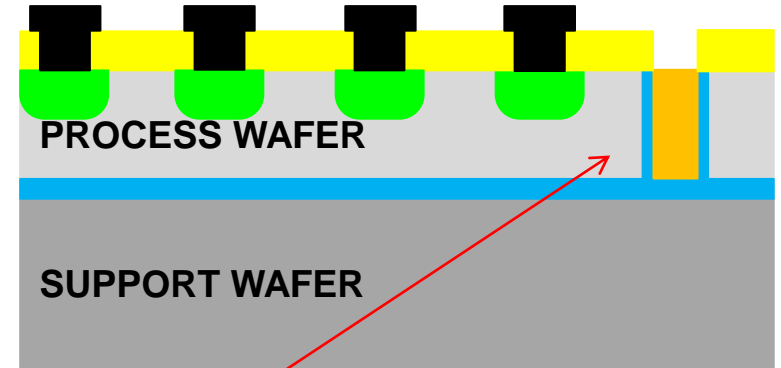
# FBK edgless technology

## Support wafers

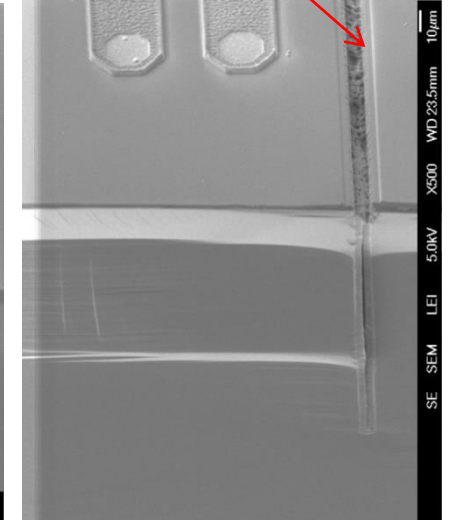
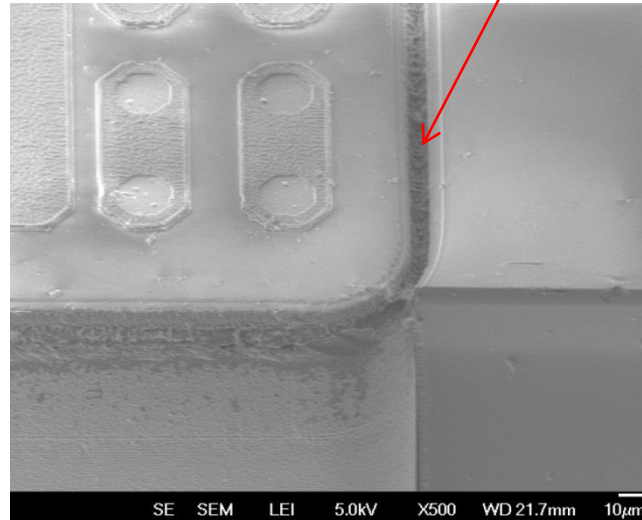
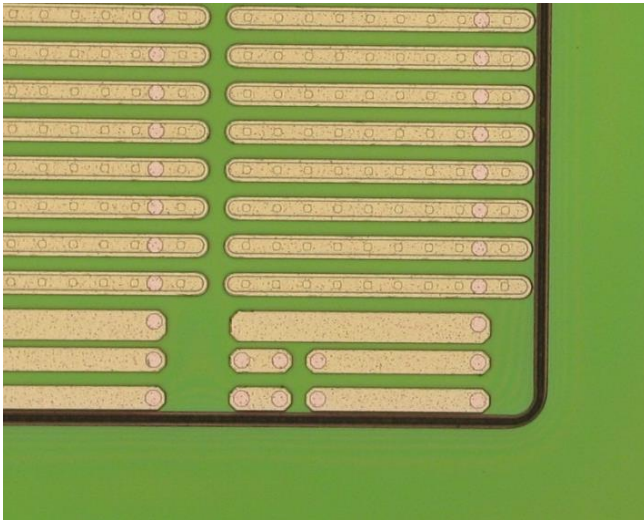
SOI wafers, epi, ... Si-Si

## DRIE etched trench and doping

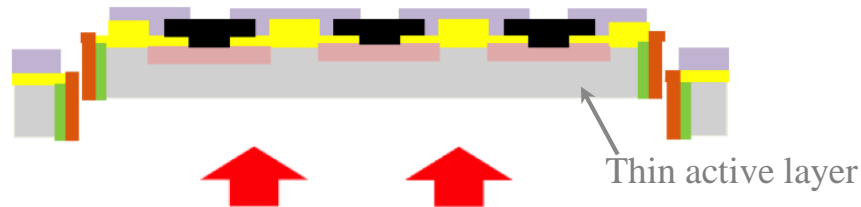
- Trench definition and etching (DRIE)
- Doping using gas or solid source technology
- Trench filling with polysilicon



*Trench filled with polysilicon*



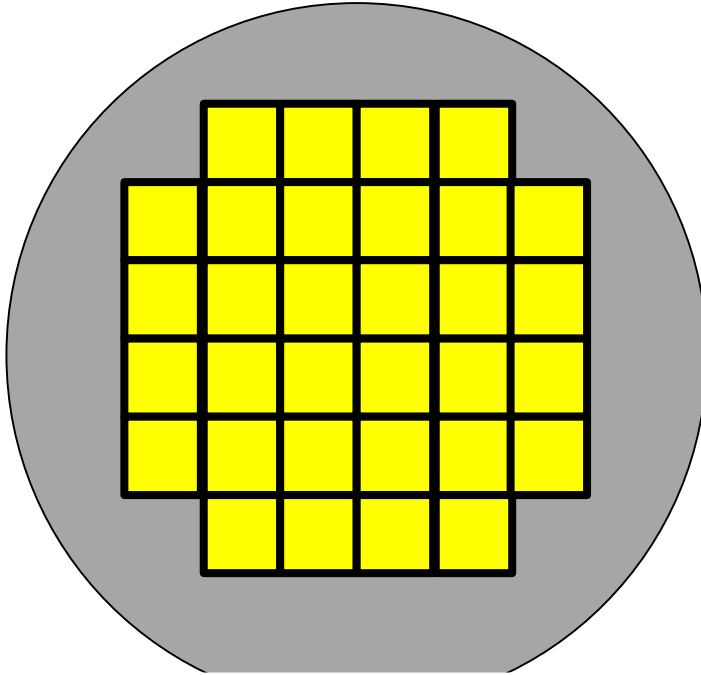
# Thin & Edgeless Sensor



## Device separation along the trenches

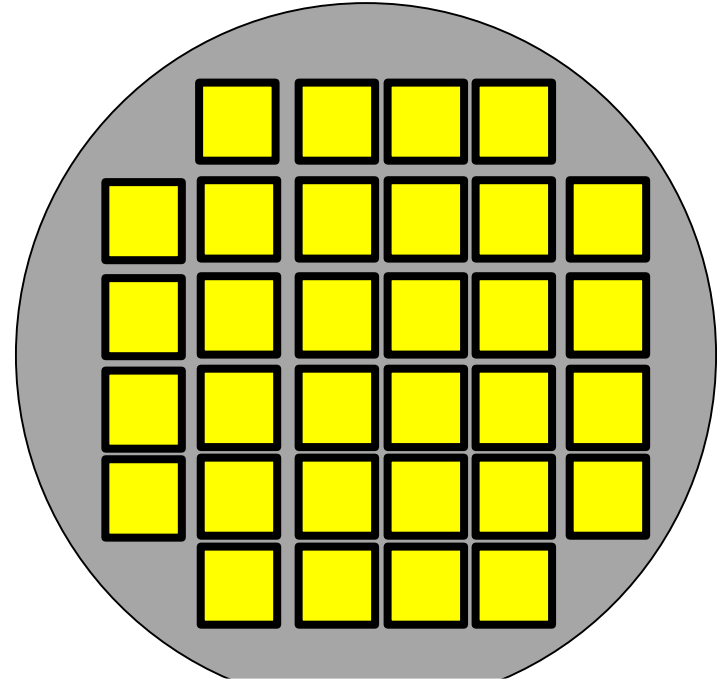
- A thin layer of heavily doped substrate is left, acting as an ohmic backside contact.
- If required for the bias contact, the device can finally be metallized on backside.
- Wafer thinning = separation

# «grid»



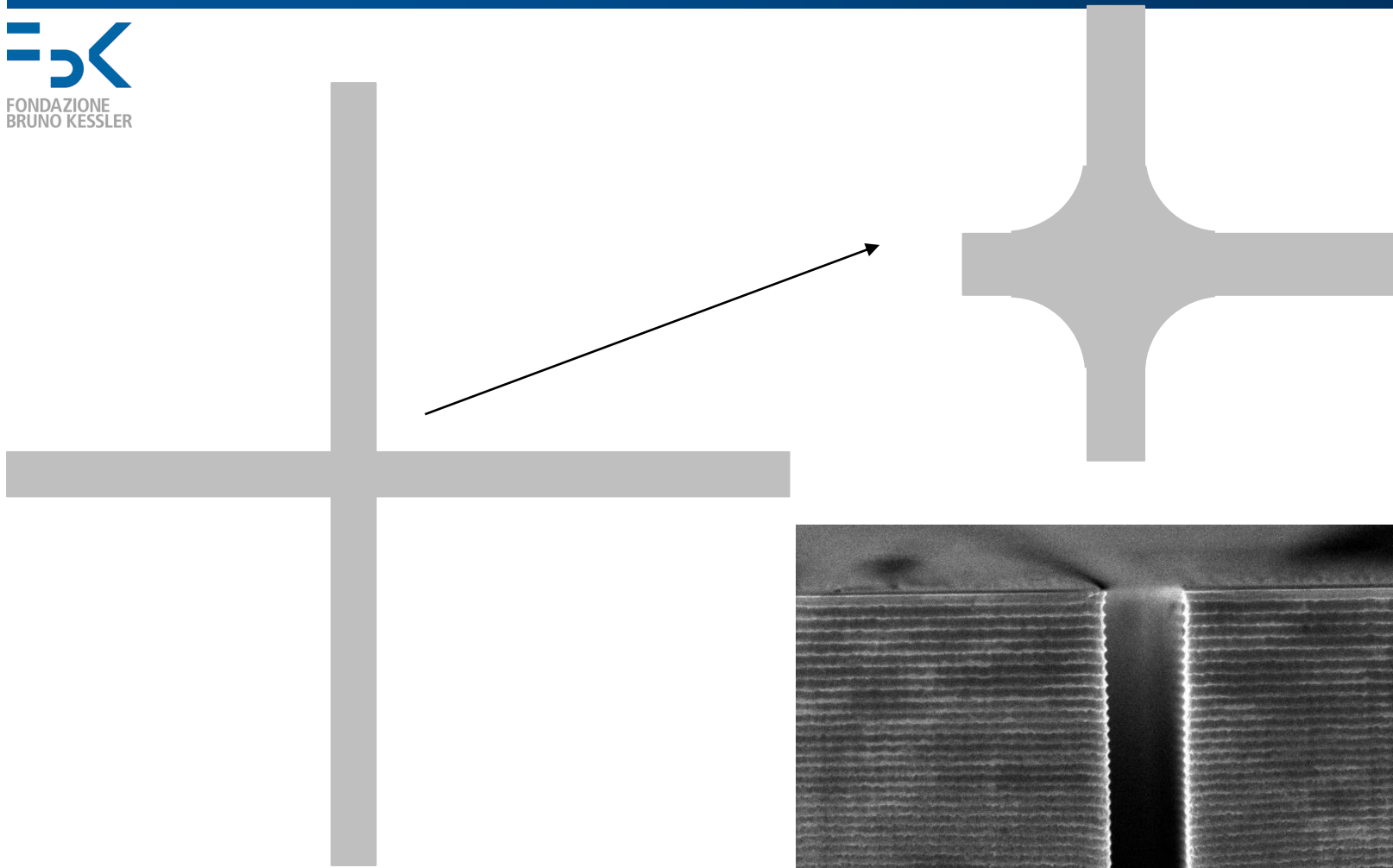
Easy (maybe) DIE separation

# «island»

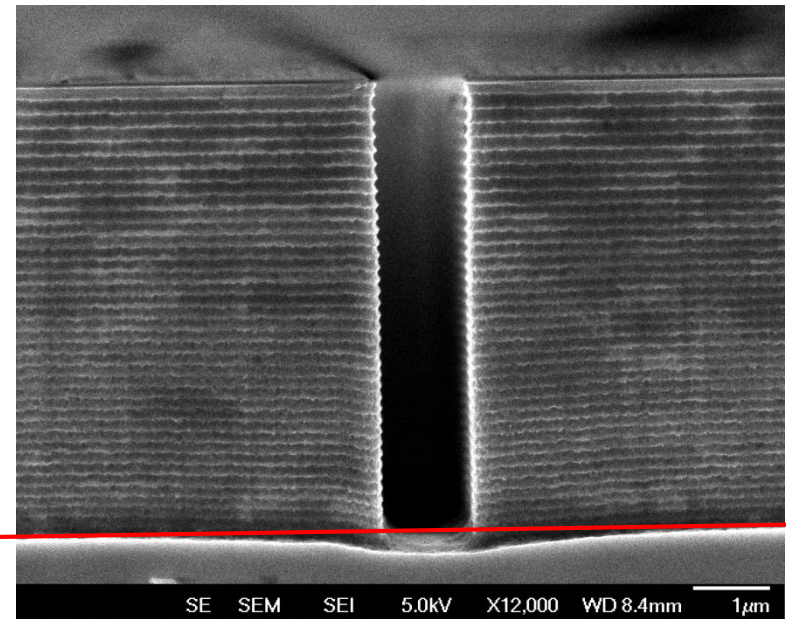


Avoid problem in the definition of the corner



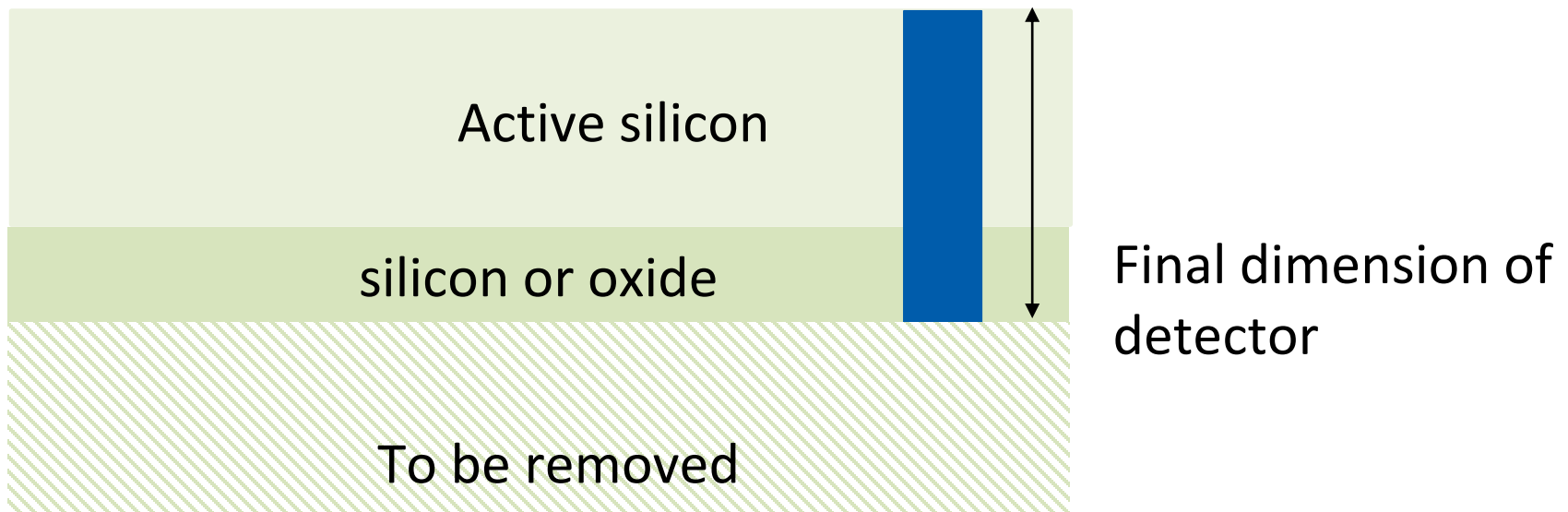


- Local increase of DRIE etch rate
- Not easy to fill



## Trench depth

Si-Si or Epi related to the final depth of the device  
In SOI the buried oxide stop the etch (maybe)



## **Wafers SOI or epi vs SI-SI**

*In my opinion the main difference is in the thinning procedure:*

- *SI-SI grinding*
- *SOI grinding + chemical etch (Si OXIDE as etch stop ?)*

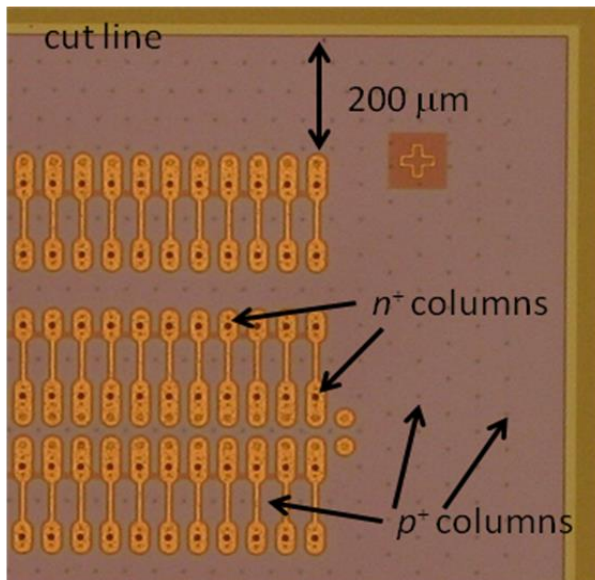
## **NON UNIFORMITY**

- *Wafer thickness*
  - *Active wafers*
  - *Support wafer*
- *Trench depth*
  - *Etch rate uniformity*
  - *layout*
- *Grinding*

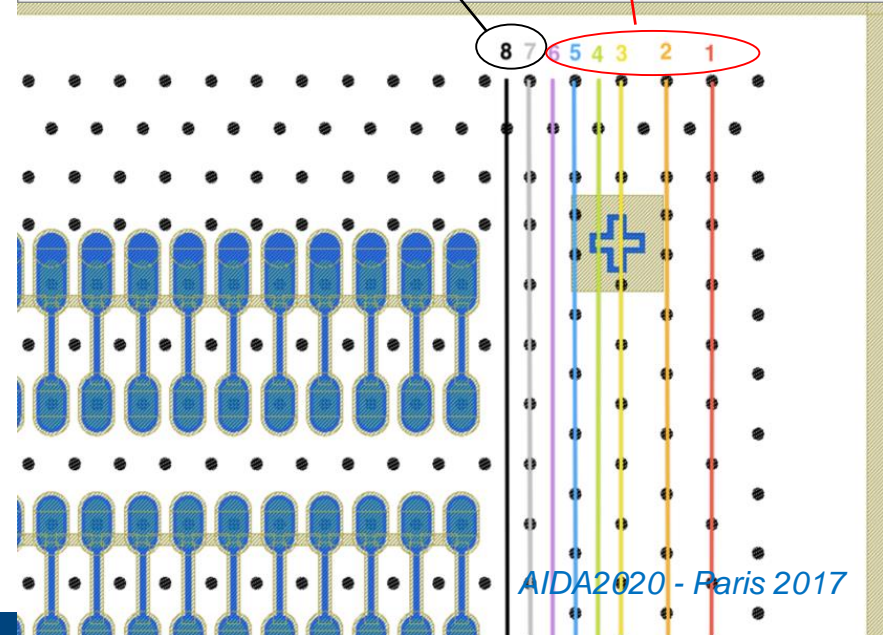
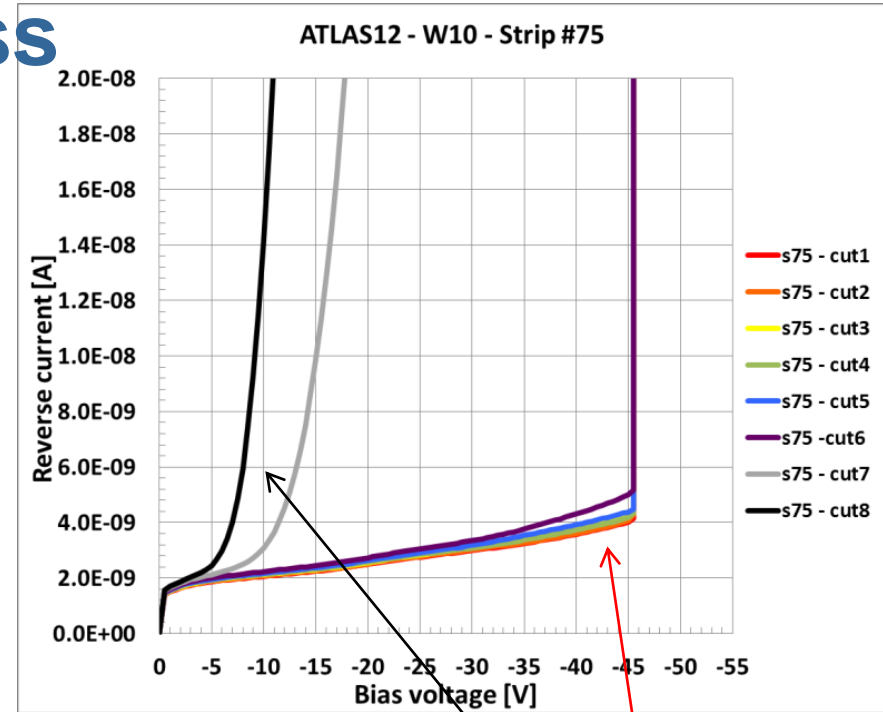


# Si-3D and edgless

In FBK Si-3D technology the active area can be terminated by a multiple columns fence = **slim edge**



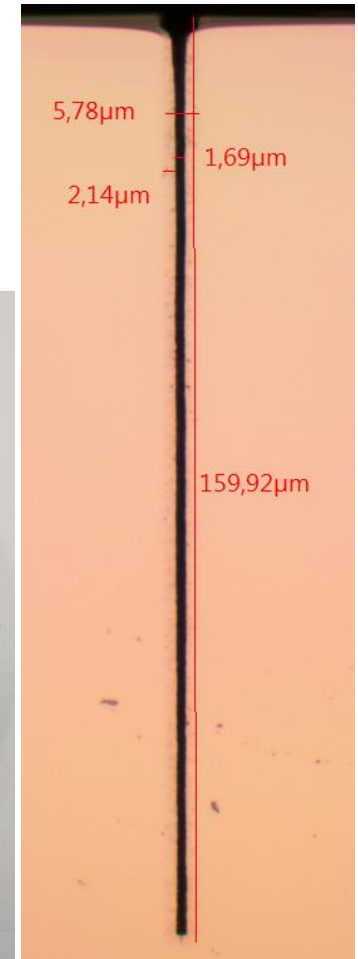
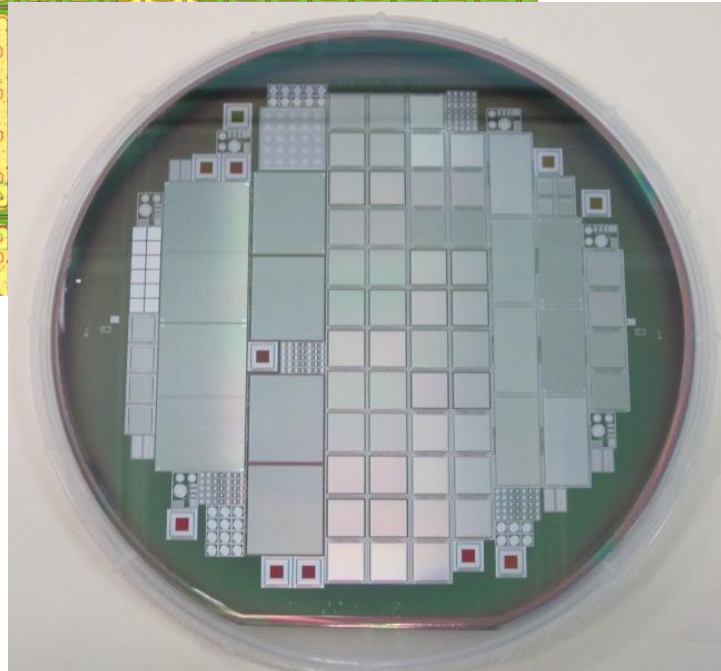
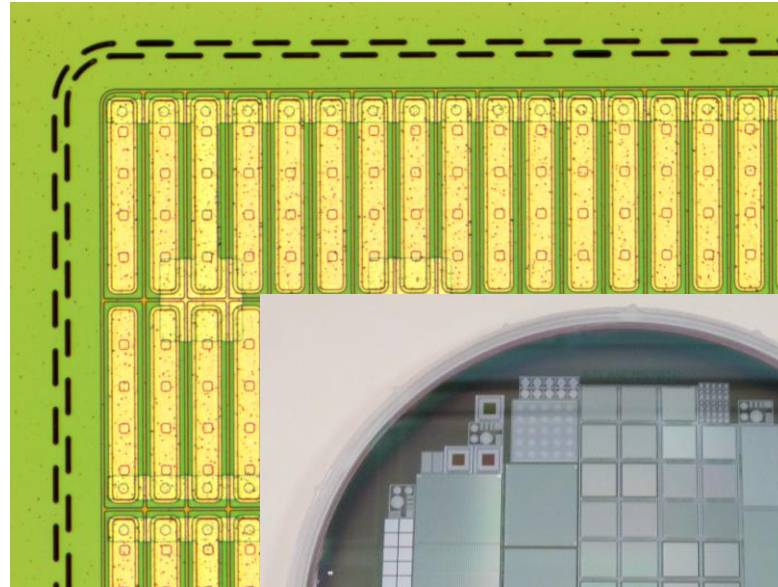
M. Povoli et al, JINST doi:10.1088/1748-0221/7/01/C01015



# Edgeless with staggered trench

## WAFER LAYOUT

- FE-I4
- Alpine
- PSI
- R4S
- RD53
- CLICK
- CHIP X
- FCP
- MGS
- HDGT



# Trench Width

## Small (less than 10um)

- simplify the litho step after trench etching
- Simplify the filling
- Trench poly filling and DIE separations

## large (about 100um)

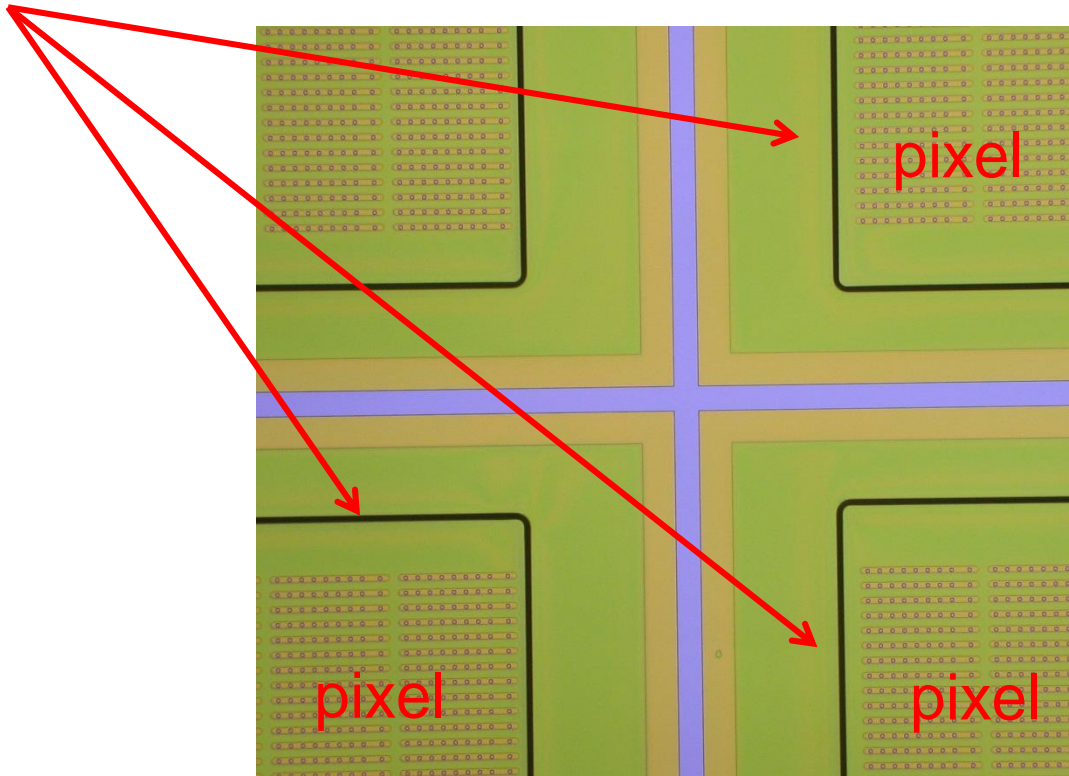
- non «standard» litho steps (dry film)

# Trench Doping

- Ion implantation
- Gas or solid source
- Poly doped in situ
- Al<sub>2</sub>O<sub>3</sub> ??



trench



Scribe line