FONDAZIONE BRUNO KESSLER

Proposal for the organization of an RD50 project aimed at the realization of an Edge-less Device

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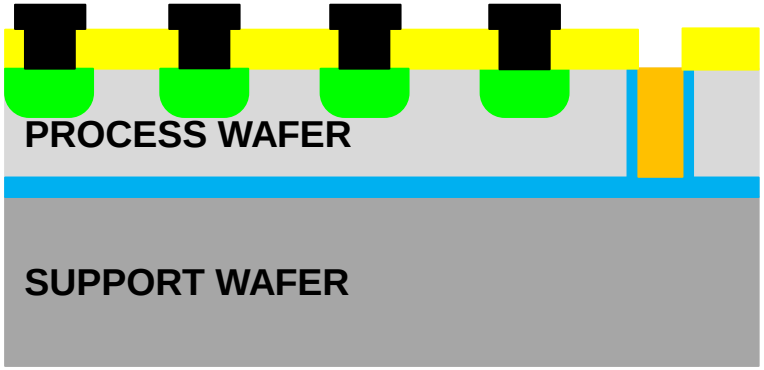
RD50

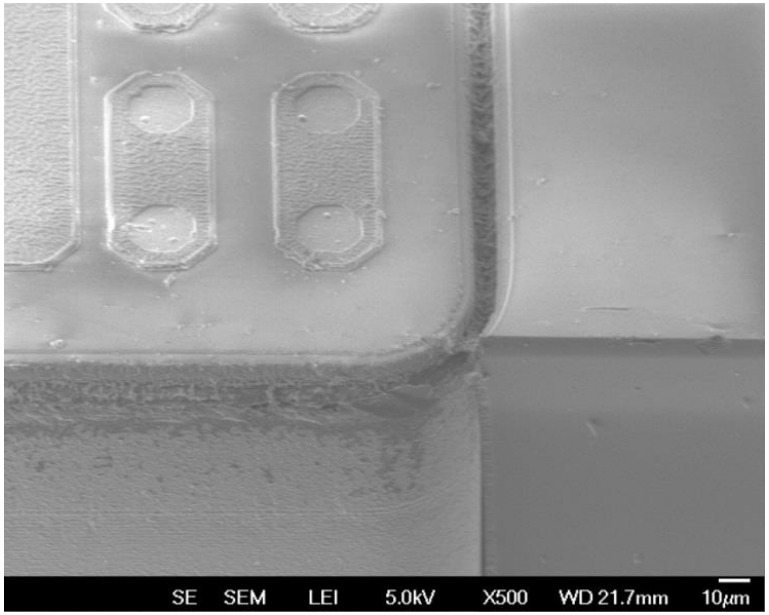
Introduction

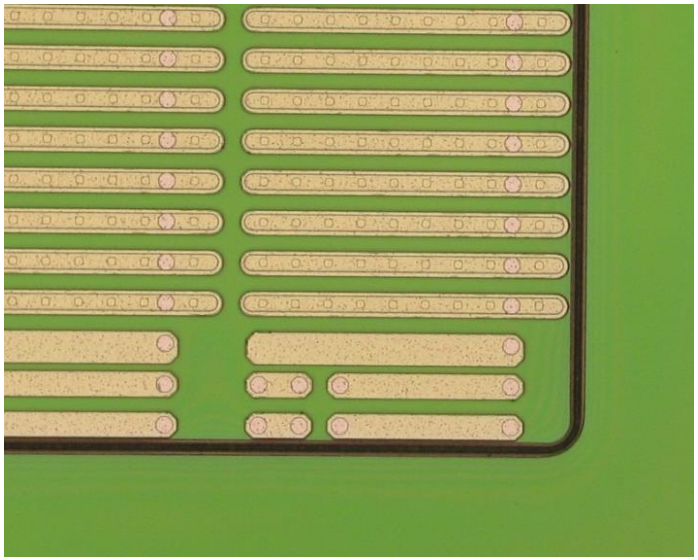
- The aim of the talk is to show at the RD50 community a proposal for realization of a edgeless detector.
- we suggest to use the idea proposed by Fadeyev (SCIPP) to use the alumina as passivation layer.
- We propose to extend this approach by inserting it directly into the process flow
- In order to obtain a process simplification.

Active edge detector: FBK past experience

- Epi, Si-Si or SOI wafers
- Trench defined by DRIE
- Doping by gas source: BBr_3 or $POCl_3$
- Trench filled (partially) with polysilicon



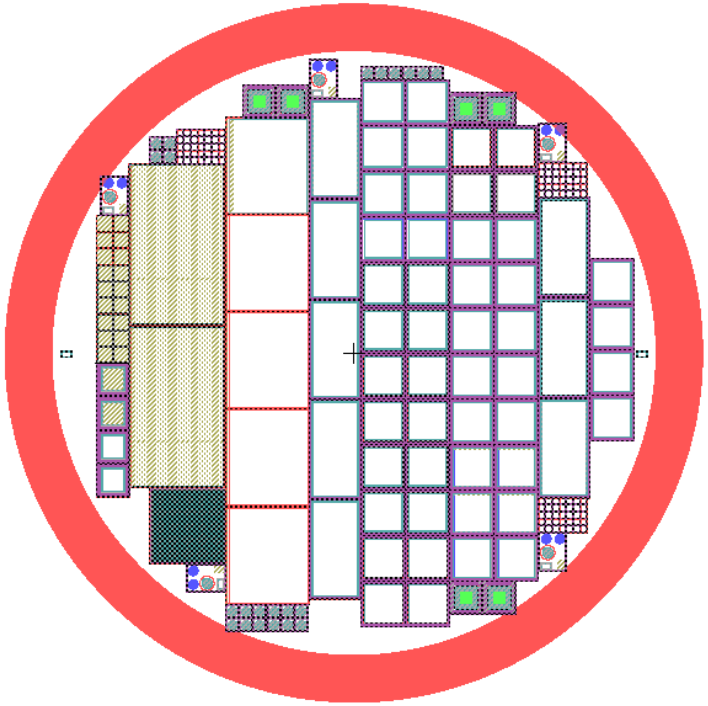


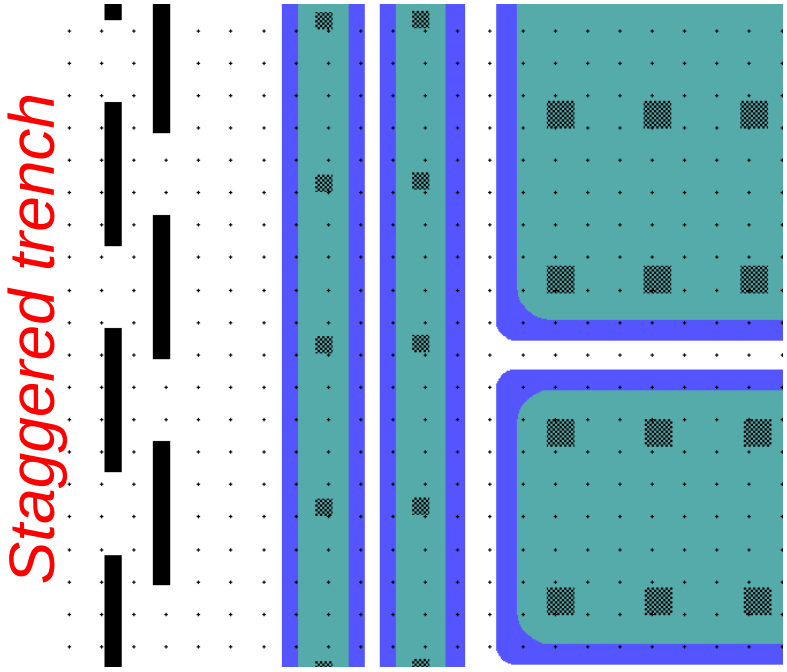


Past activity in partnership with ALICE , LPNHE Paris, Università di Trieste , Ginevra e Trento

Active Edge on thin substrate

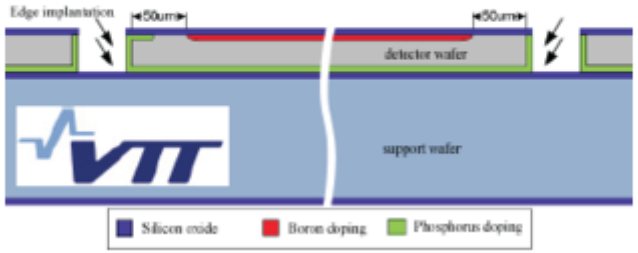
- ATLAS & CMS pixels
- Si-Si & SOI
- n-on-p technology
- Fabrication on going





Other experiences:

- VTT : large trench, doping by ion implantation



- Si3D : reduce the lateral dead area. In FBK: Column fence all around the device see "Slim edges in double-sided silicon 3D detectors" M Povoli et al. JINST , vol 7, January 2012

- Die passivated with allumina see Fadeyev et al. NIM A 765 (2014) 59-63

Technical proposal 1/4

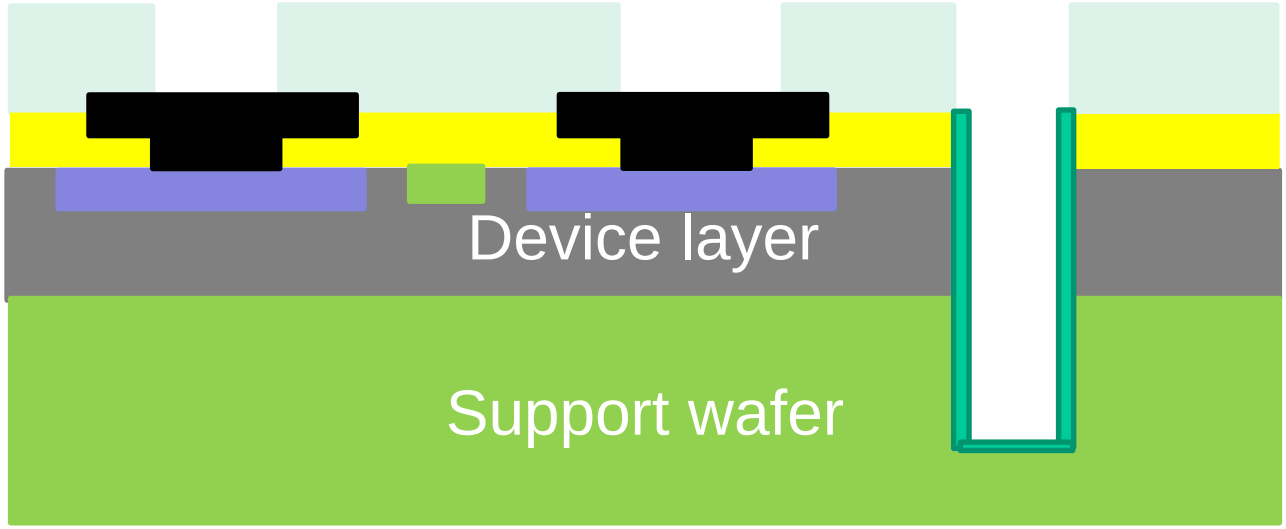
beyond sensor fabrication, we have to consider :

i) Process
ii) UBM
iii) thinning
iv) Separation

extend the alumina approach by inserting it directly into the process flow and not as a post process

Technical proposal 2/4

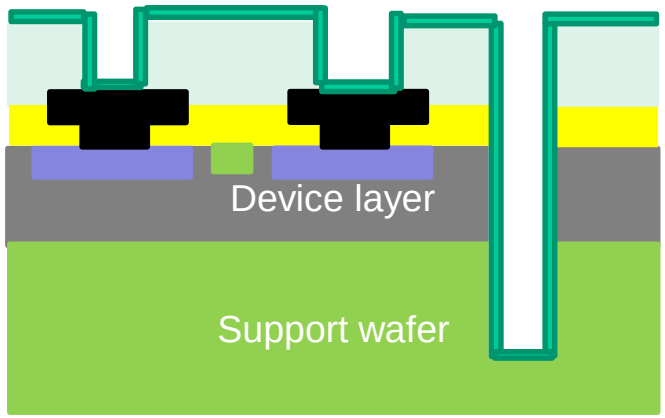
- Realize the devices on Si-Si or SOI wafers with a “standard” planar process
- As the last step (last lithographic step) define and etch the trenches
- Passivation with Al_2O_3 deposited by Atomic Layer Deposition (ALD) in FBK.



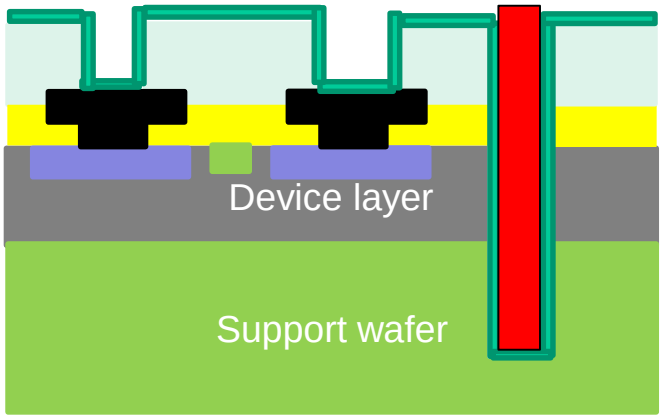
Technical proposal 3/4

- Main issues
  - Control the level of negative charge into alumina
  - Alumina definition
  - UBM deposition , electroless ?
  - Radiation hardness
  - ….

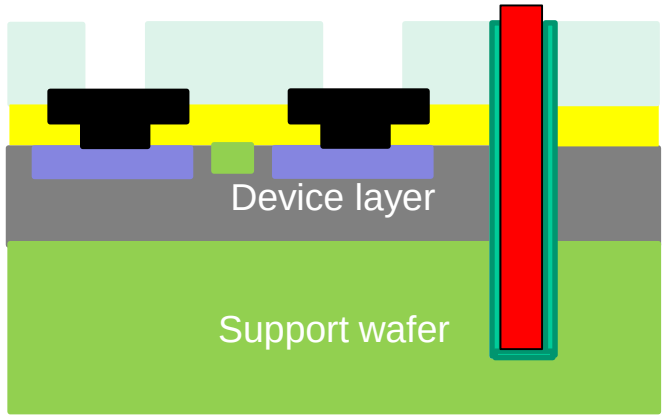
Technical proposal 4/4



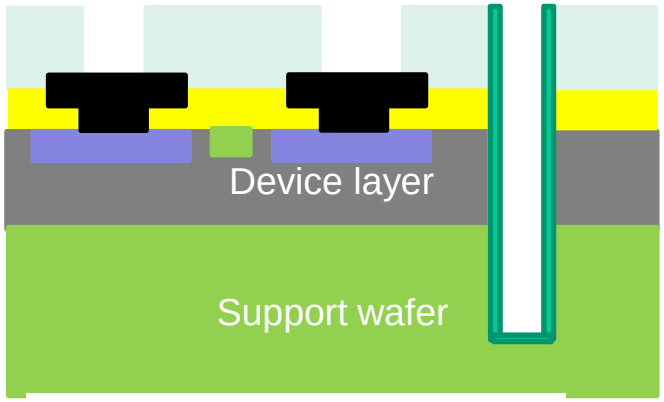
a) Al2O3 deposition



b) Fill the trench with a polymer



c) Remove the Al2O3 from surface



d) Remove the polymer

Past exeprience: HYDE project

- Partnership between FBK e Univ. Trento University (GF Dalla Betta, Roberto Mendicino)
- Neutron detector: the trench are passivated with allumina
- Negative charge in the range of 10^{12} cm^{-2}

"Initial results from new 3D neutron detectors" R. Mendicino et al. JINST, vol 11, November 2016

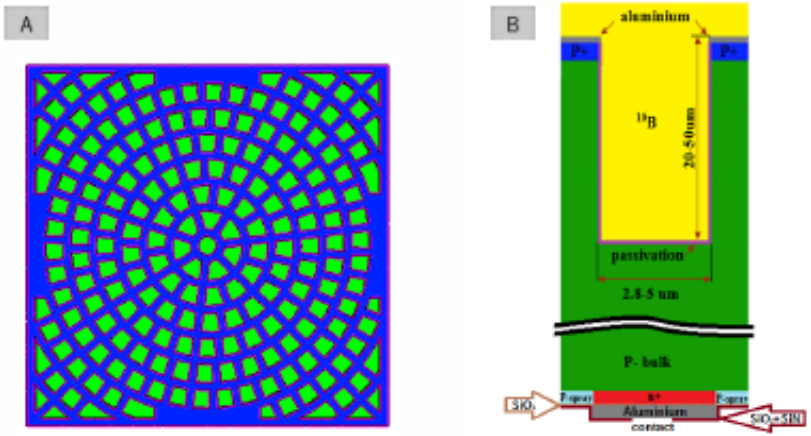


Figure 1. A) Top view of the sensitive area. It consists of a web structure able to withstand the thermal dilatation forces. B) Schematic cross-section of the 3D sensor with detail of a single cavity.

Project

Goal: the development of a technology (design, manufacture, UBM, thinning and separation) that allows the realization of an edge-less detector bsed on trench passivation by Al_2O_3

Phase 1: technological test wafers

- Define the «optimal» trench width
- Al_2O_3:
  - deposition and annealing, control the charge
  - Define the Al_2O_3

Phase 2

- Define a wafers layout , device realization and preliminary test
- Characterization: electrical, optical, before and after irradiation
- ……
- UBM, thinning and separation

Now I need

- Comments and suggestions from everyone
- Institutions \ colleagues available to participate
  - FBK
  - BNL
  - SCIPP
  - MPI Munich
  - LPNHE
  - ……

More info on
http://tredi2017.fbk.eu/