

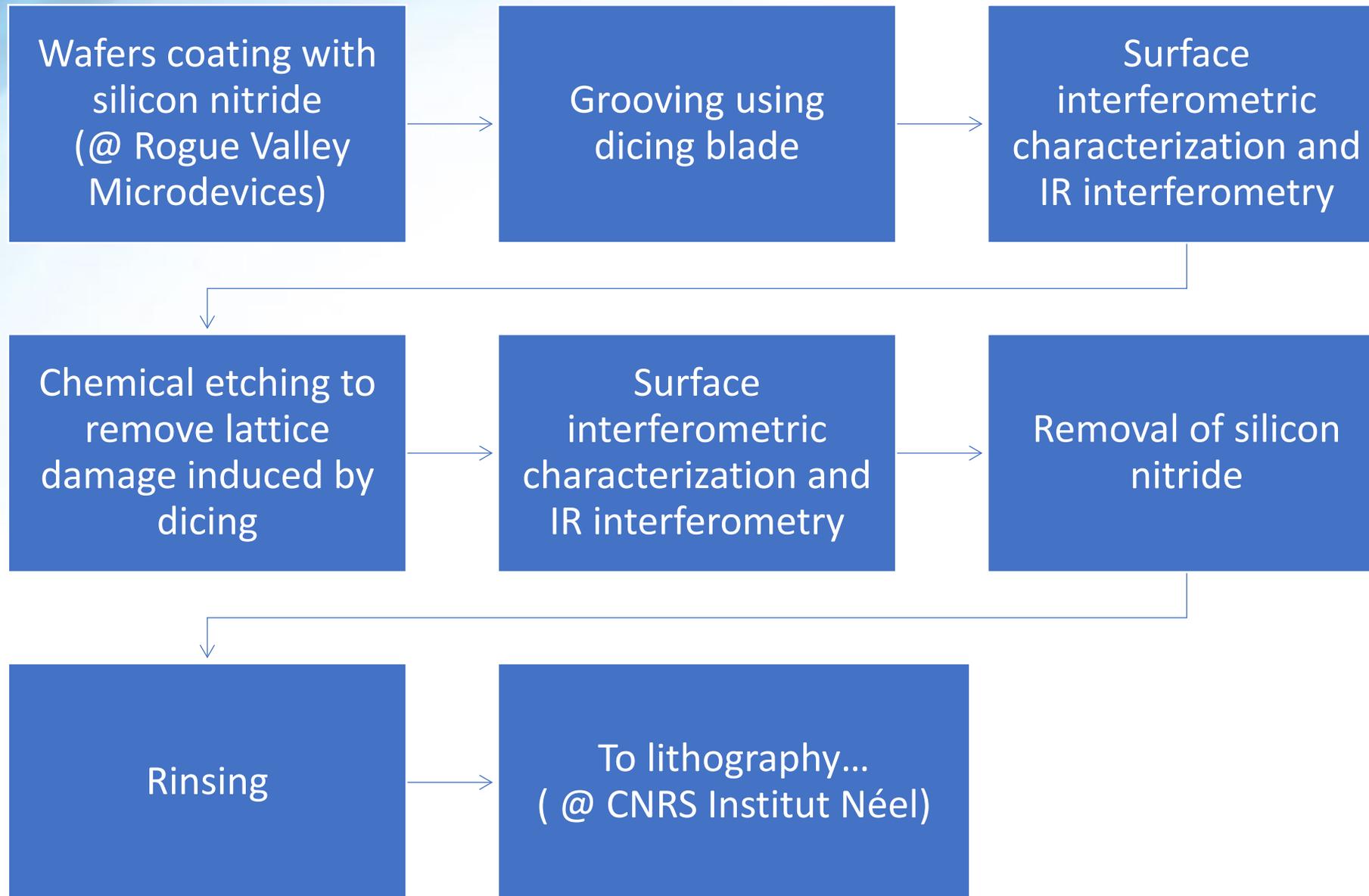
Wafer Dicing

Andrea Mazzolari 16/01/2025



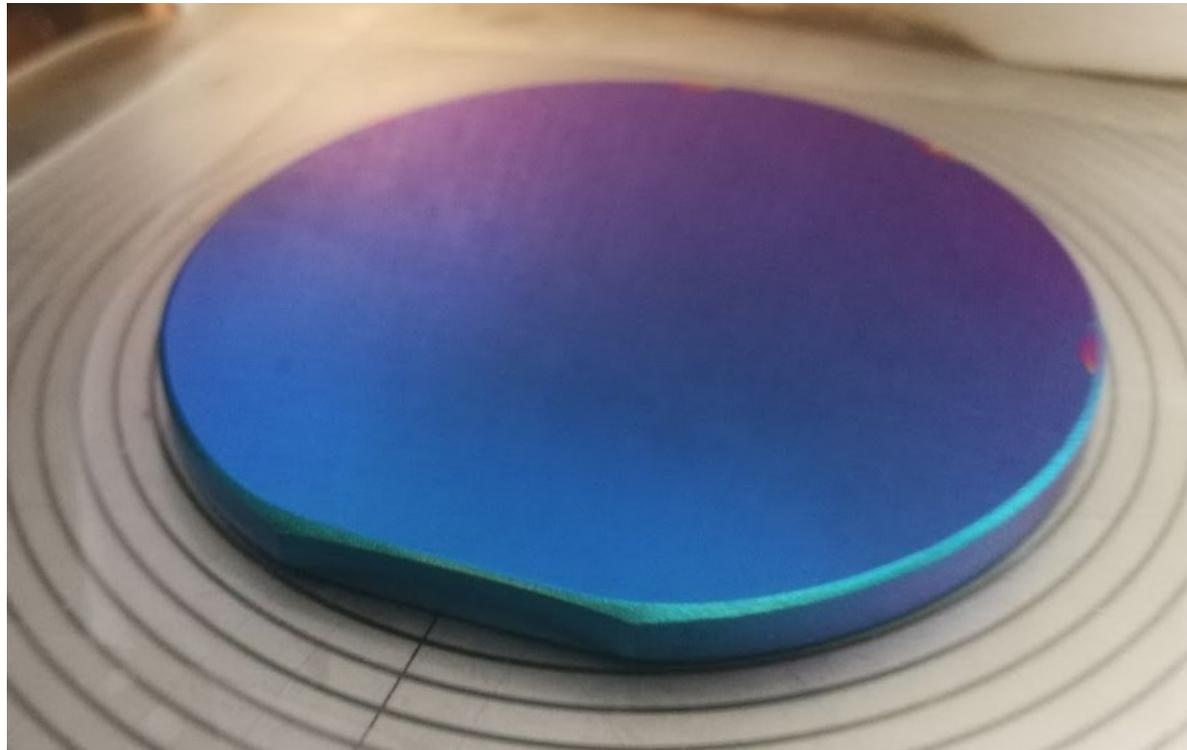
**Università
degli Studi
di Ferrara**

PROCESS



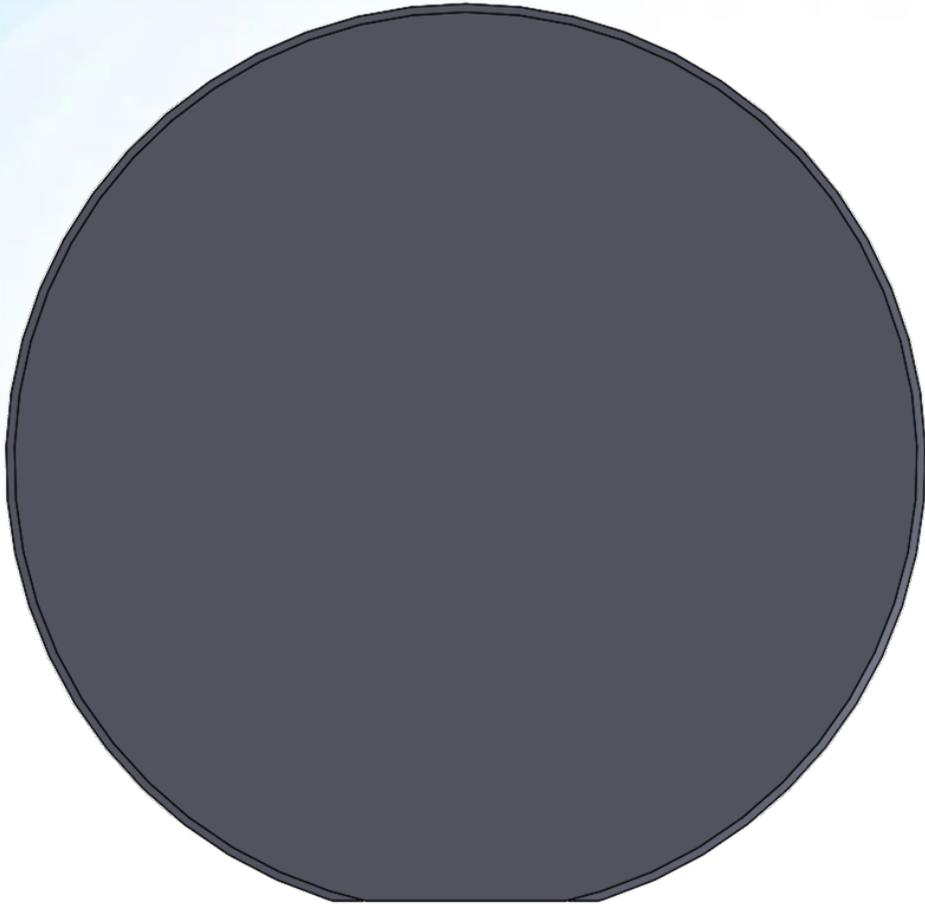
PROCESS

- Wafers coating with silicon nitride (@ Rogue Valley Microdevices)
 - Silicon nitride acts as masking agent against chemical etching, preserving the surfaces of the wafer later used for deposition of thin films

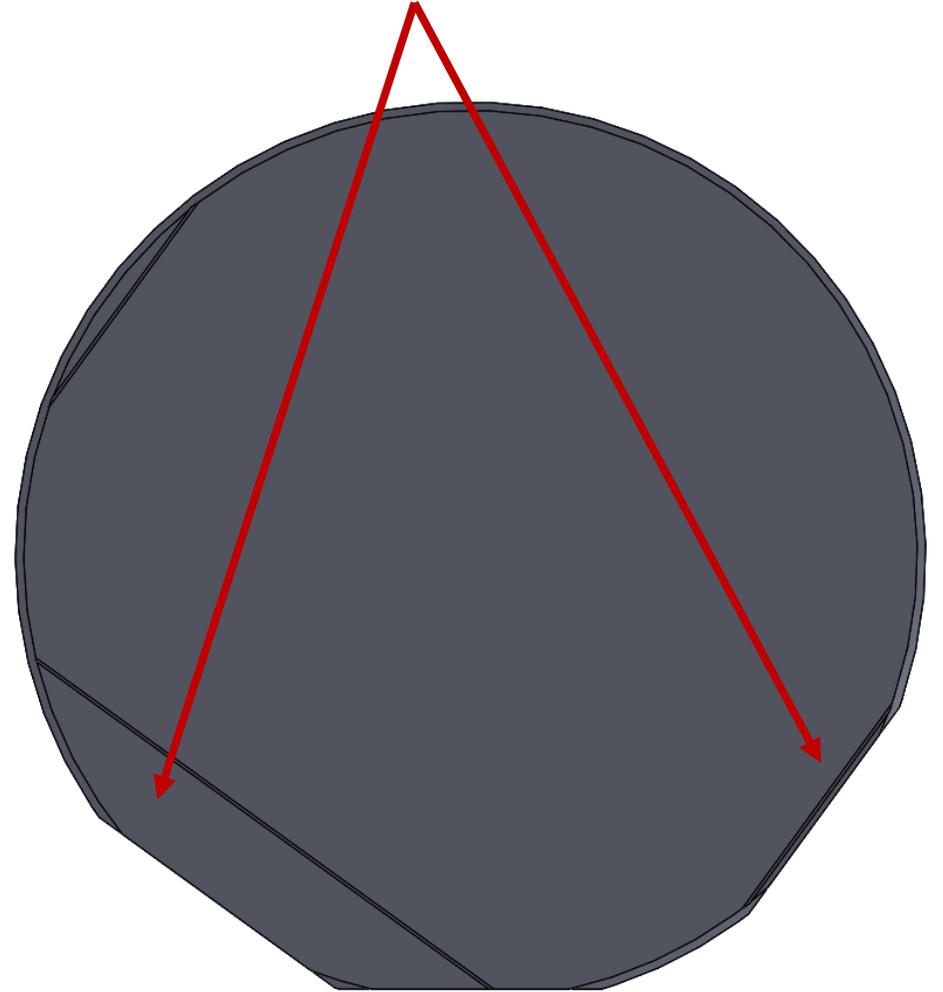


FLATS MACHINING

Starting wafer

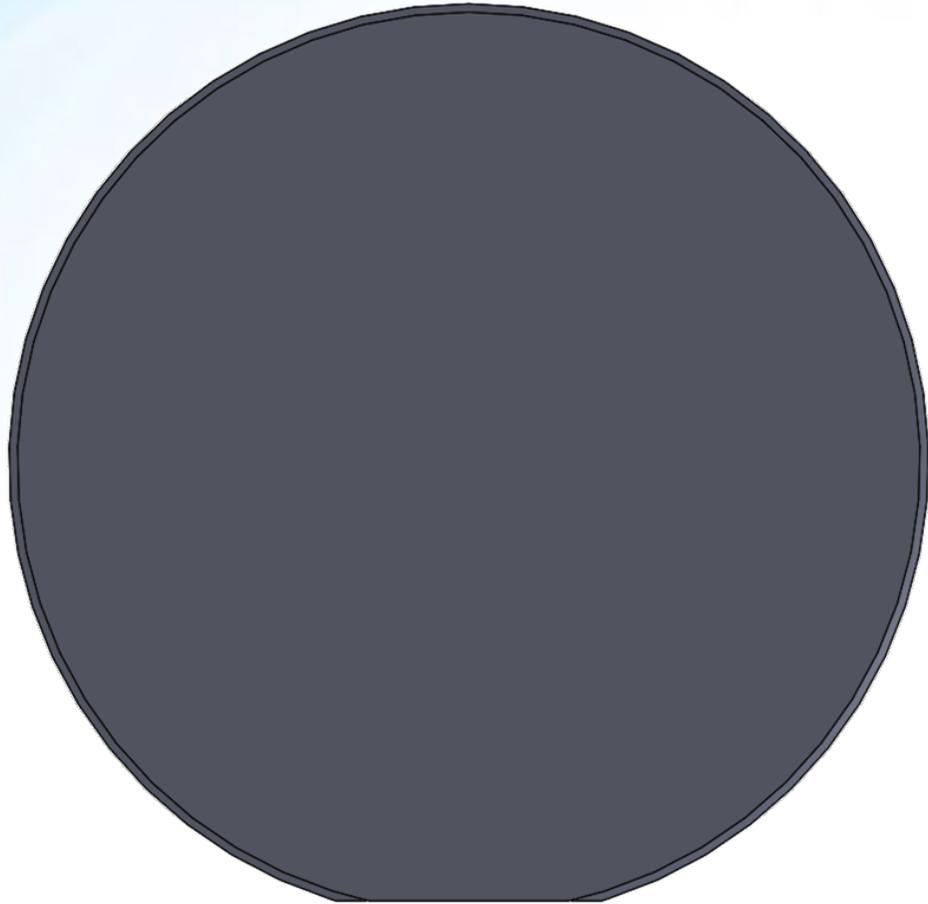


- Additional flats are machined to avoid cleave planes.

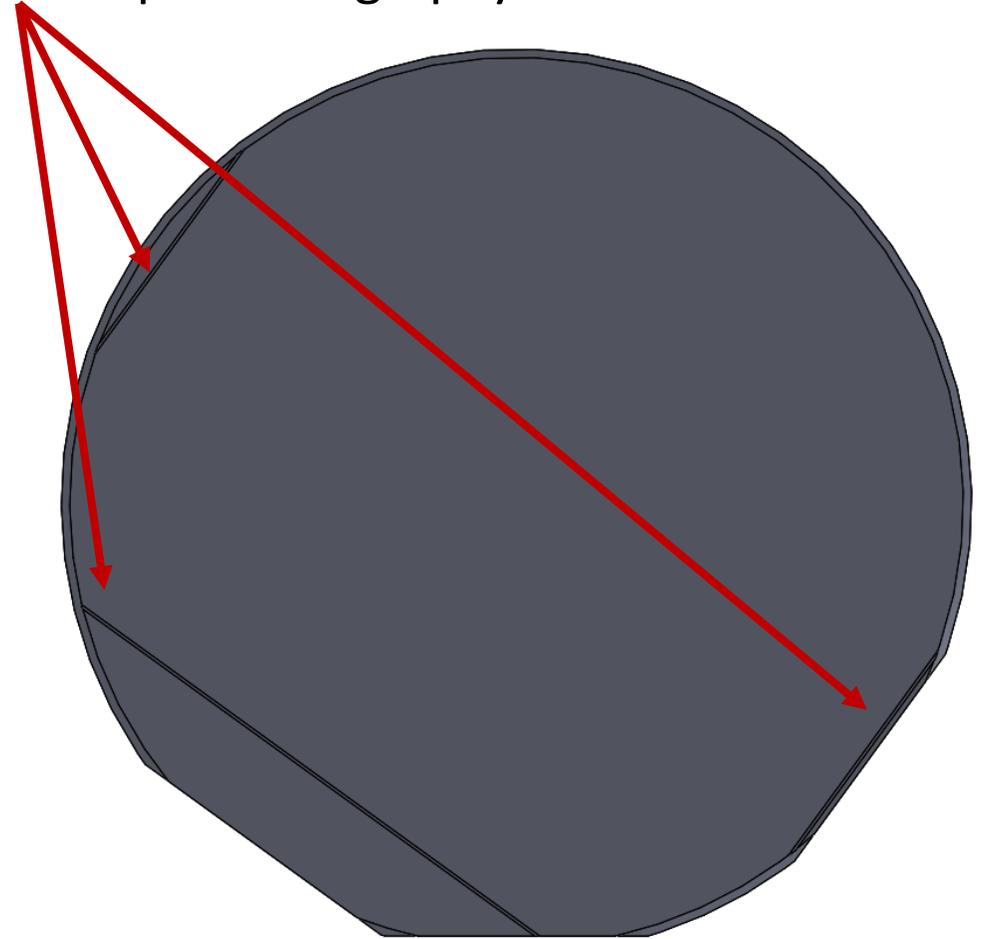


FLATS MACHINING

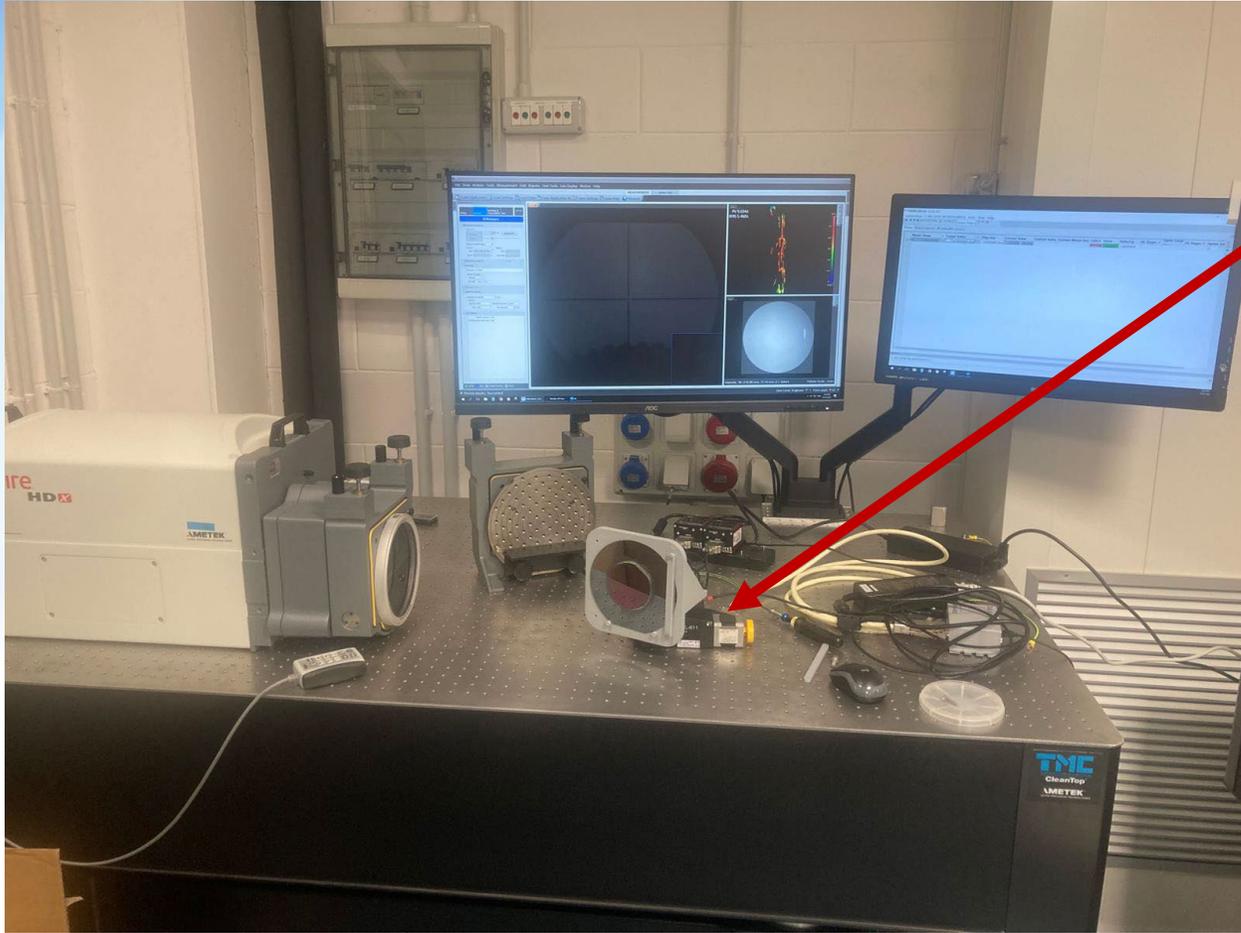
Starting wafer



- Additional flats are machined to avoid cleave planes.
- Markers for photolithography



Accuracy verification



- Wafer is mounted on a high-resolution rotary stage.
- Perpendicularity between flat surface and wafer's surface is assessed through laser interferometry
- Wafer ready for grooving
- Flats used as reference for alignment operations

Dicing of crystals

BULLKIDs are diced from a commercially available wafer using a fine-grit blade to minimize the mechanical damage during the cut.



Dicing machine

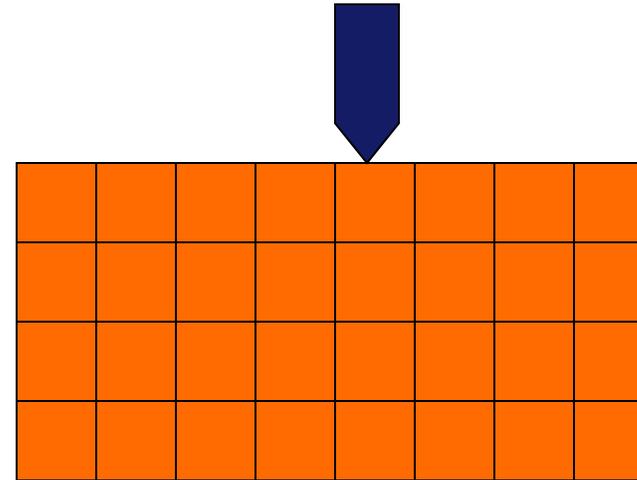
- Cut centre positioning precision: ± 0.01 mm
- Cut direction precision: $\pm 0.01^\circ$
- Cut depth precision: ± 0.005 mm
- Minimal cut width: 0.08 mm
- Maximum cut width: 1 mm
- Maximum cut depth: 5 mm
- Materials: Semiconductors (Si, Ge, SiC, GaAs..) and crystals in general, glass, ceramics

Dicing of crystals

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Dicing machine

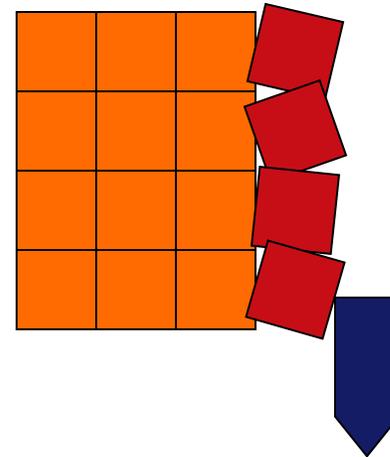


Dicing of crystals

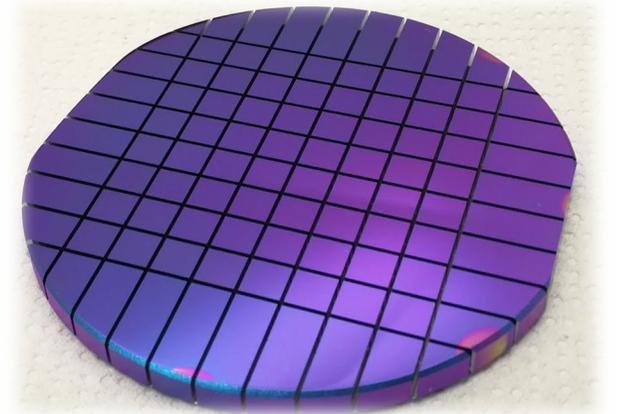
BULLKIDs are diced from a commercially available wafer using a fine-grit blade to minimize the mechanical damage during the cut.



Dicing machine



damage is generated at surface,
which can obstruct the final performance
of the BULLKIDs



IR interferometry



- IR interferometry used to measure thickness of common frame. Exploit Si transparency to IR
- Measurement is carried before and after chemical etching to assure proper removal of silicon.
- Precision can reach sub-micrometer resolution on thin samples (<1mm) and $\approx 1\mu\text{m}$ in thick samples

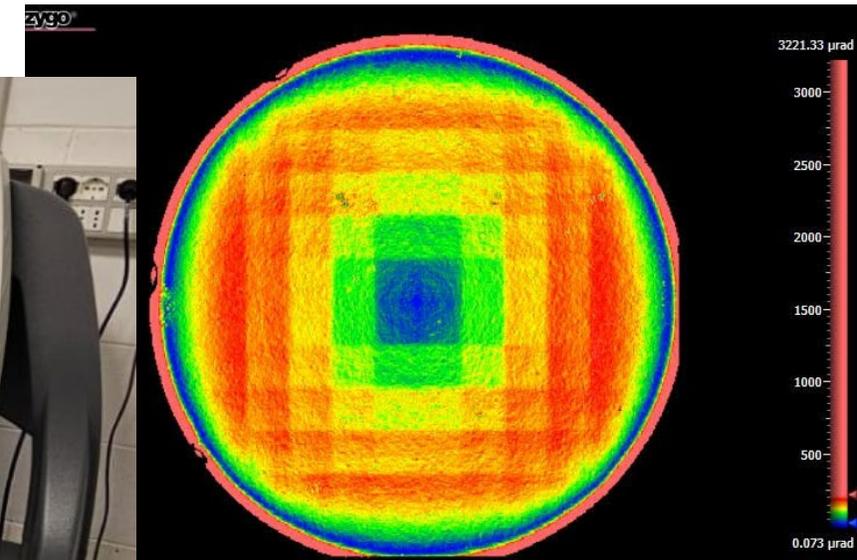
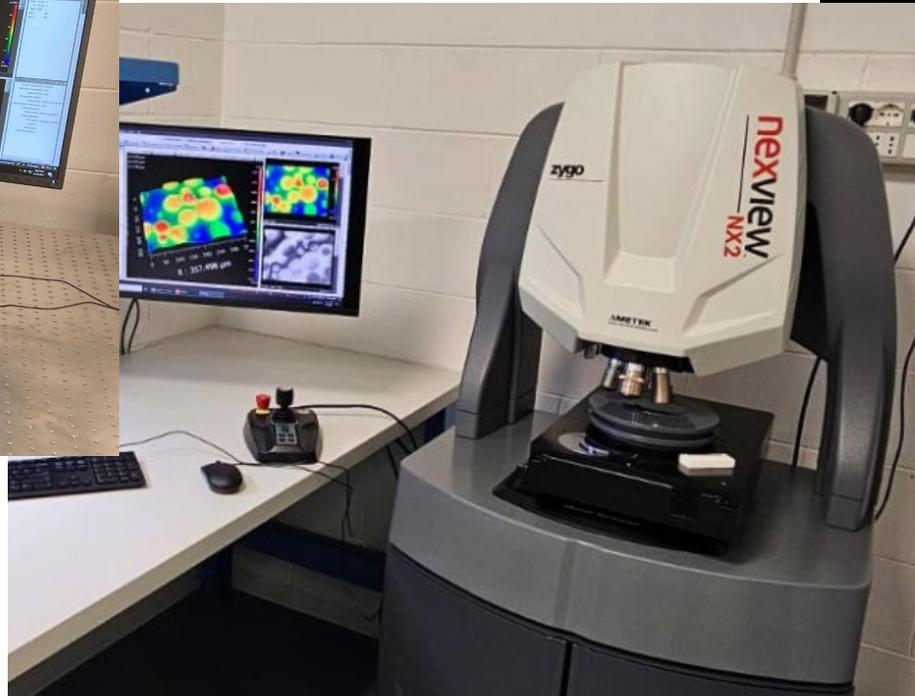
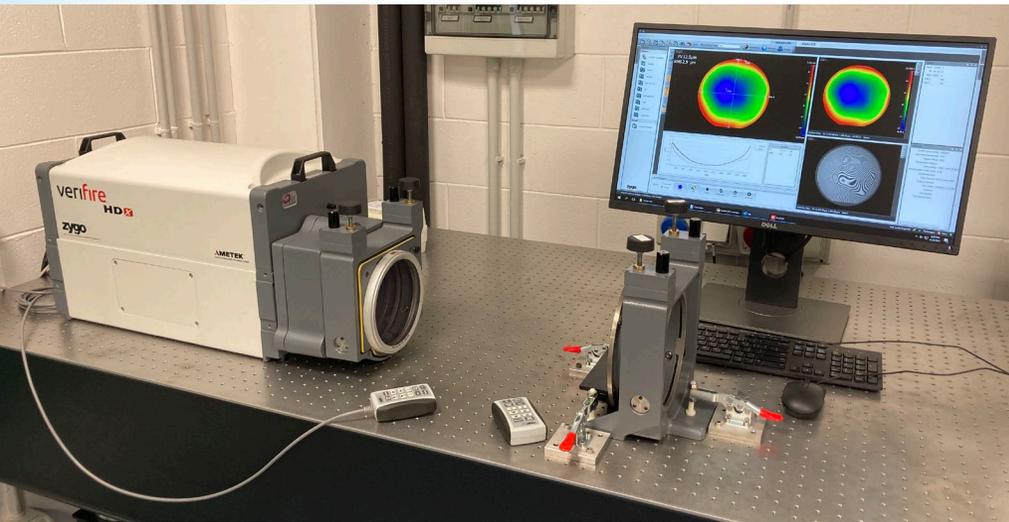
White light interferometry



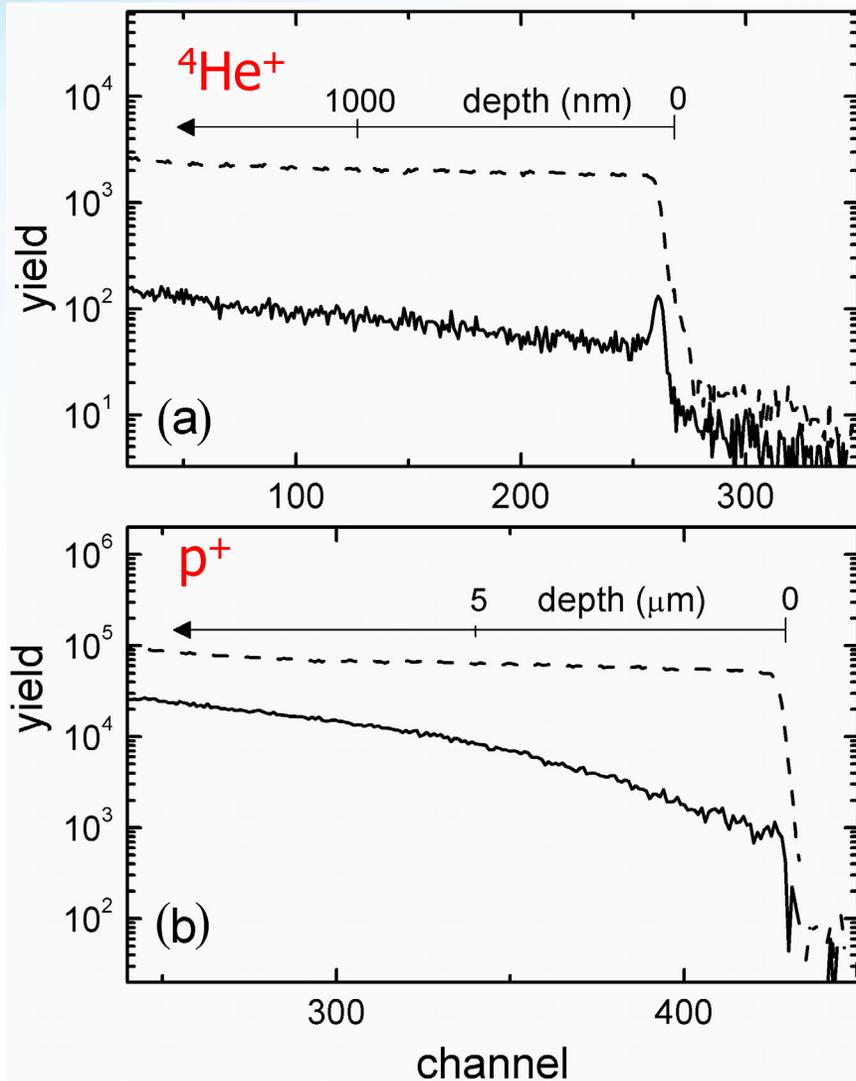
- White light interferometry is used to assess depth and width of the grooves before and after chemical etching
- Recently acquired an automated software for faster acquisitions

Laser interferometry

- Optical interferometry is a well-assessed method to characterize flatness of reflective surfaces.
- Used to characterize stress state before and after the chemical etching.
- Characterization performed before and after chemical etching to assure complete removal of the stressed and damaged regions.

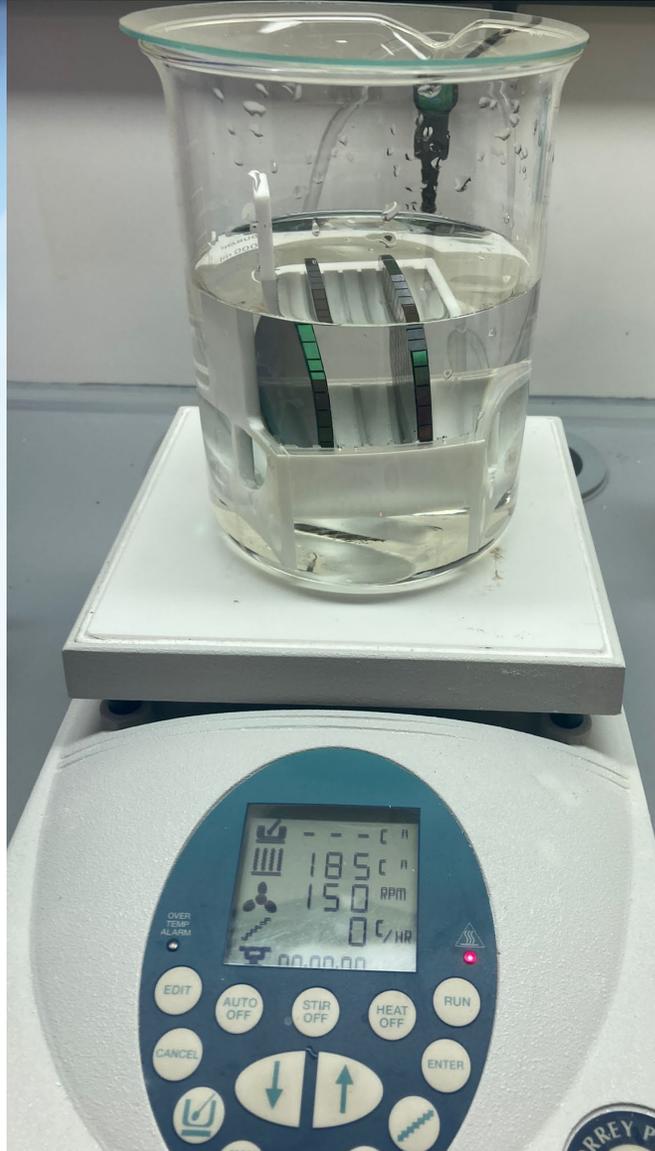


CHEMICAL ETCHING

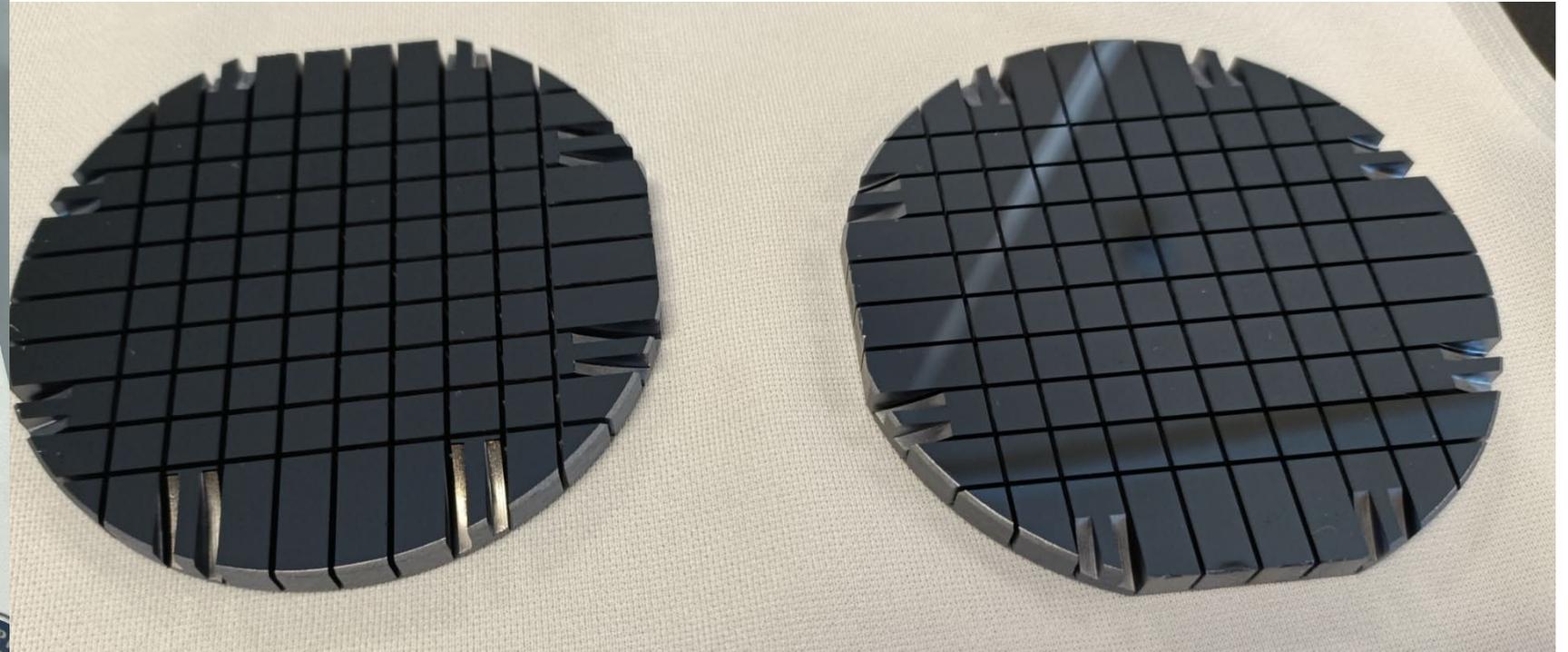


Chemical etching is used to remove lattice damaged regions.

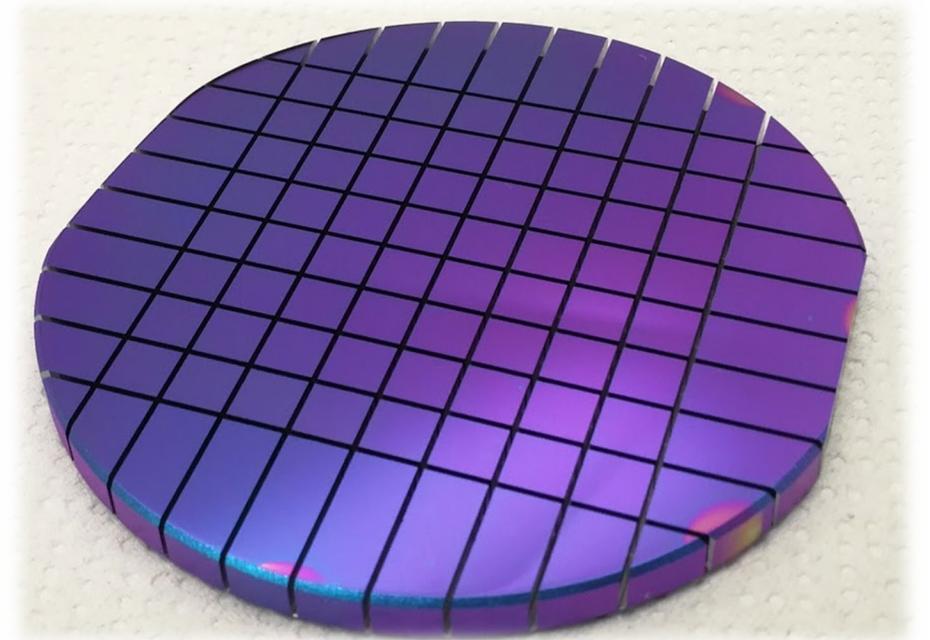
Low signal of backscattered particles means good crystalline quality



Silicon nitride is removed in hot H_3PO_4 ,
leaving final BULLKID2 wafers

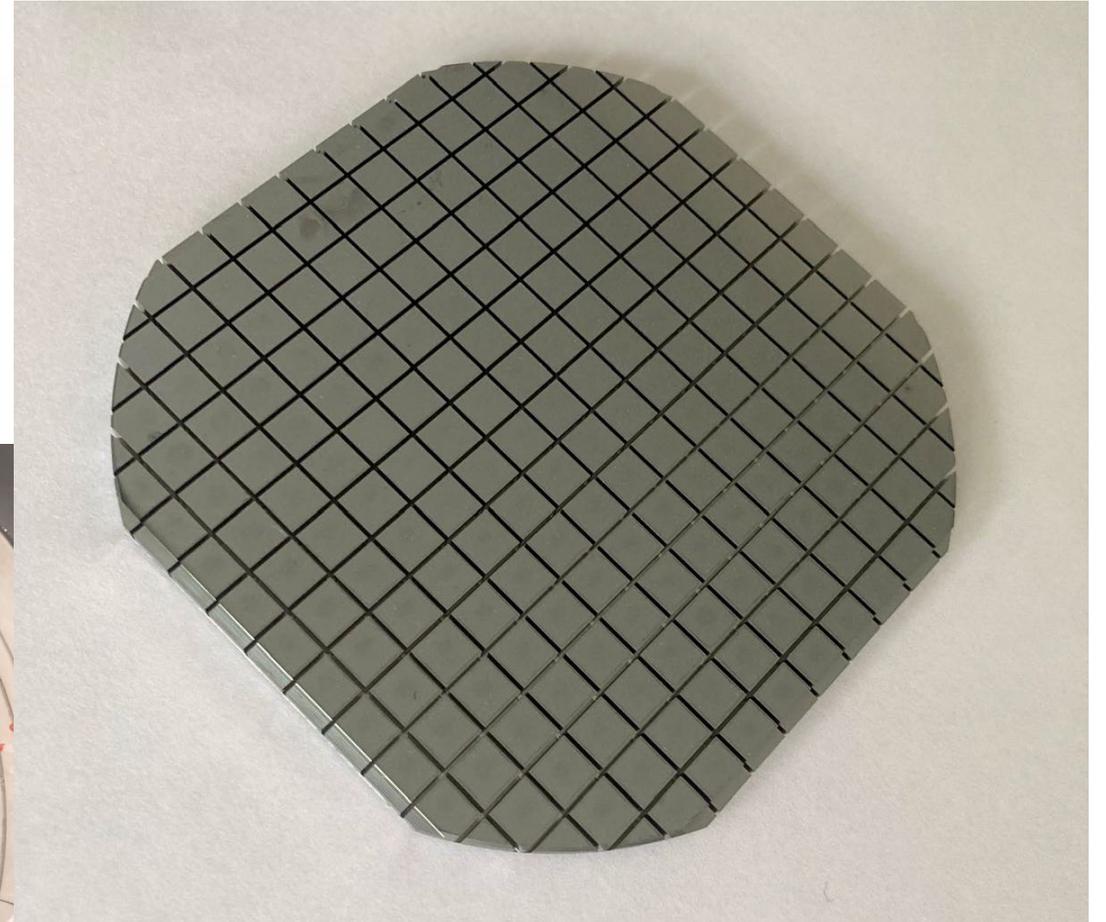
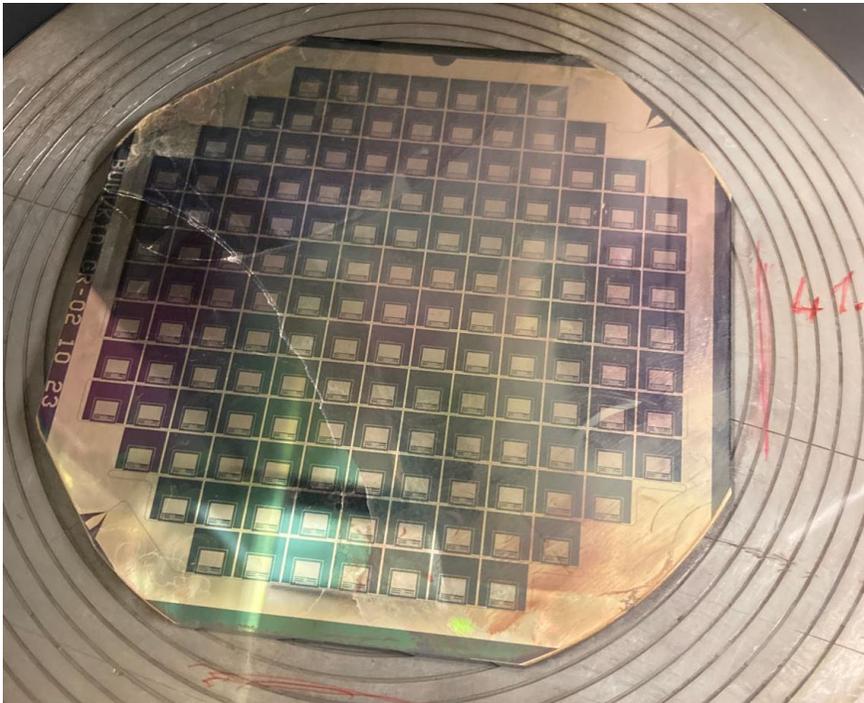


- 4 wafers are going to be processed in Ferrara
- We are going to coat 25 more wafers of diameter 3''



Moving toward 4" wafers

- First tests of dicing of 4" Si wafers are successful
- We now have 10 wafers already coated and ready for processing



Dual laser system

Dual laser engraving system will soon aid manufacturing of references on opposite wafers surfaces.

Aim is to lowering wafer processing time.

Pre-alignment of the lasers accomplished

Fine allignment will be carried on test-wafers

