DE LA RECHERCHE À L'INDUSTRIE

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SCREEN PRINTING IN SACLAY

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Irfu

INTRODUCTION

- Bulk Micromegas detectors are manufactured in Saclay MPGD workshop since 3 years (~ 150 units).

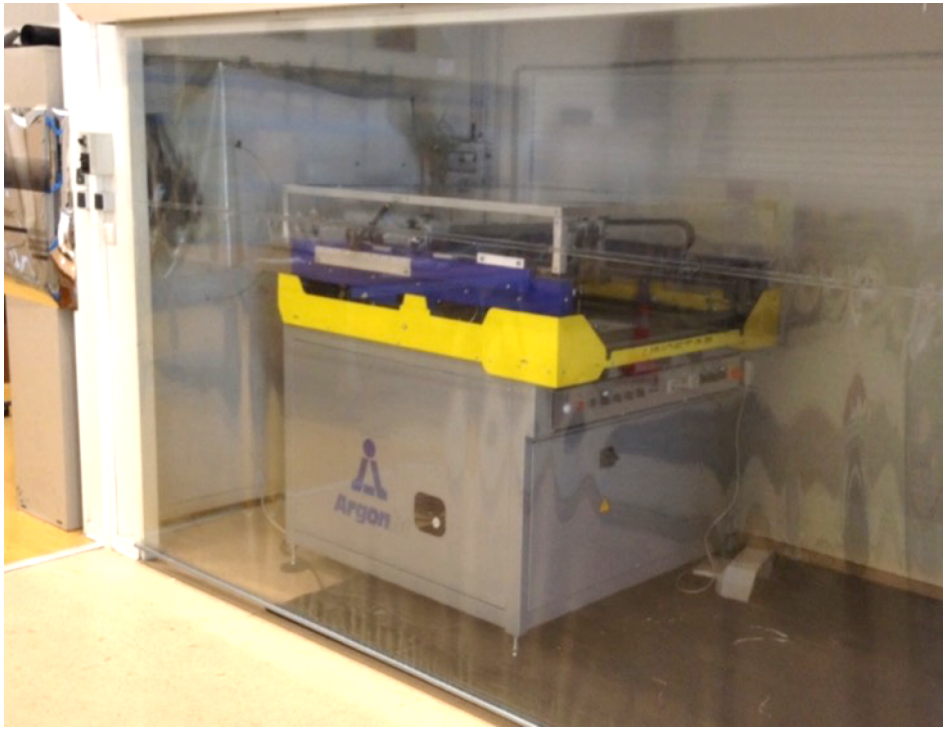
- In 2014 the workshop was upgraded with a serigraphy machine in order to print resistive pattern on top of readout PCB before bulk processing.

- Goal of the serigraphy @ Saclay:
    - thin strips and/or thin inter strips (< 100 µm) on large surface (600 mm x 600 mm)
    - Gain experience with resistive strips
    - R&D program:
        - different patterns of resistive coating (strips, plain layer, pad,…)
        - different resistive paste (dilution or carbon adding)
        - use of insulating paste and/or silver conductive paste

- This new machine is part of a “fab-lab” together with the bulk workshop and several test benches in the same geographic area that will allow us to built and test prototypes.

SCREEN PRINTING MACHINE

- The Argon Unostar E serigraphy machine is a professional tool well suited for the type of resistive polymer to be used. Investment is ~ 30 k€ (ANR Splam)
- Maximum surface is 700 mm * 700 mm
- End 2014 a first test was done using a demonstration screen with several patterns to train IRFU technicians on this machine



TEST PARAMETERS

- Screen:
  - Stainless-steel mesh M325, SD90/40 at 15°
  - ENDUCTION on screen of 6-8µ (measure = 8 µm)
  - Theoretical thickness of paste deposition ~ 48 µm
  - tension of the screen mesh = 28 N/cm in both direction
- Resistive polymers :ESL RS 12115
- Use without addition of solvant
- Substrat for deposition: Kapton of 50µm and mylar of 60µm
- Parameters of machine Argon Unostar E (average speed and pressure)

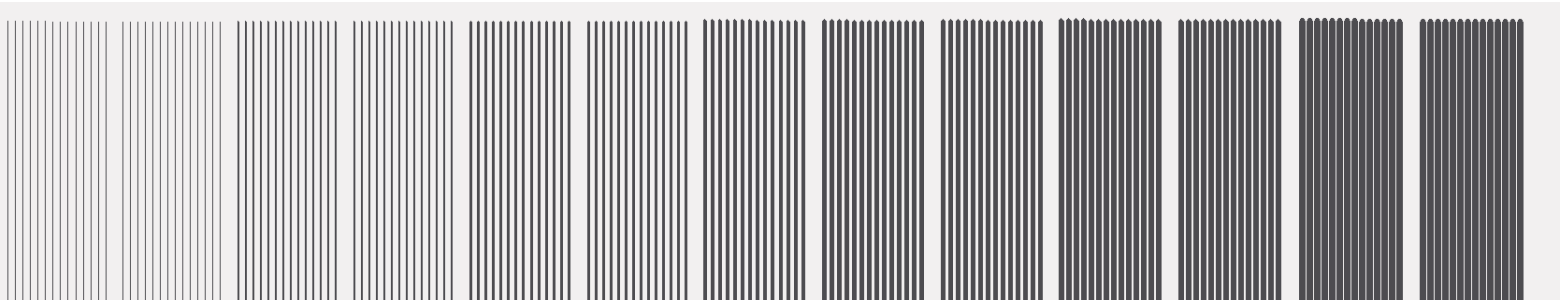
TEST SCREEN

- The test screen had several types of strips with a pitch of 700 µm, from very thin strip to very thin inter-strip. The strip length was 500 mm.

- Various other patterns (square, circle, connector, …) of various size where also on the same screen

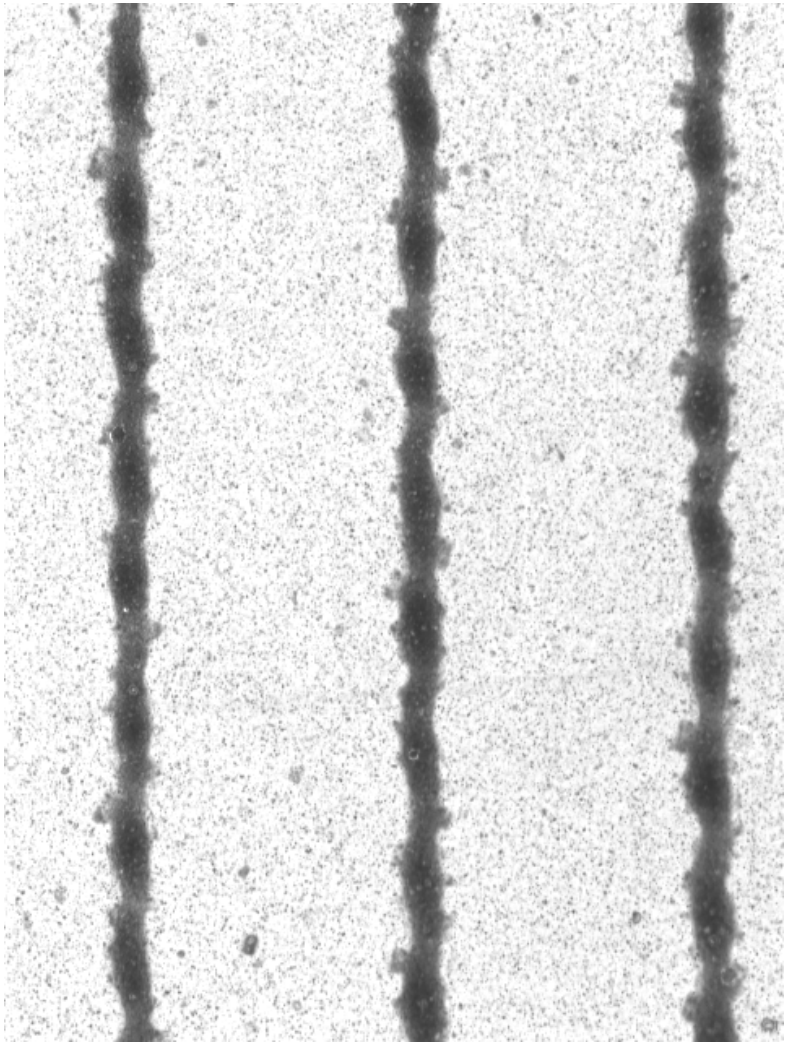
	Strip (µm)	Inter (µm)
Zone 1	50	650
Zone 2	100	600
Zone 3	150	550
Zone 4	200	500
Zone 5	250	450
Zone 6	300	400
Zone 7	350	350
Zone 8	400	300
Zone 9	450	250
Zone 10	500	200
Zone 11	550	150
Zone 12	600	100
Zone 13	650	50

Zone 1 Zone 13



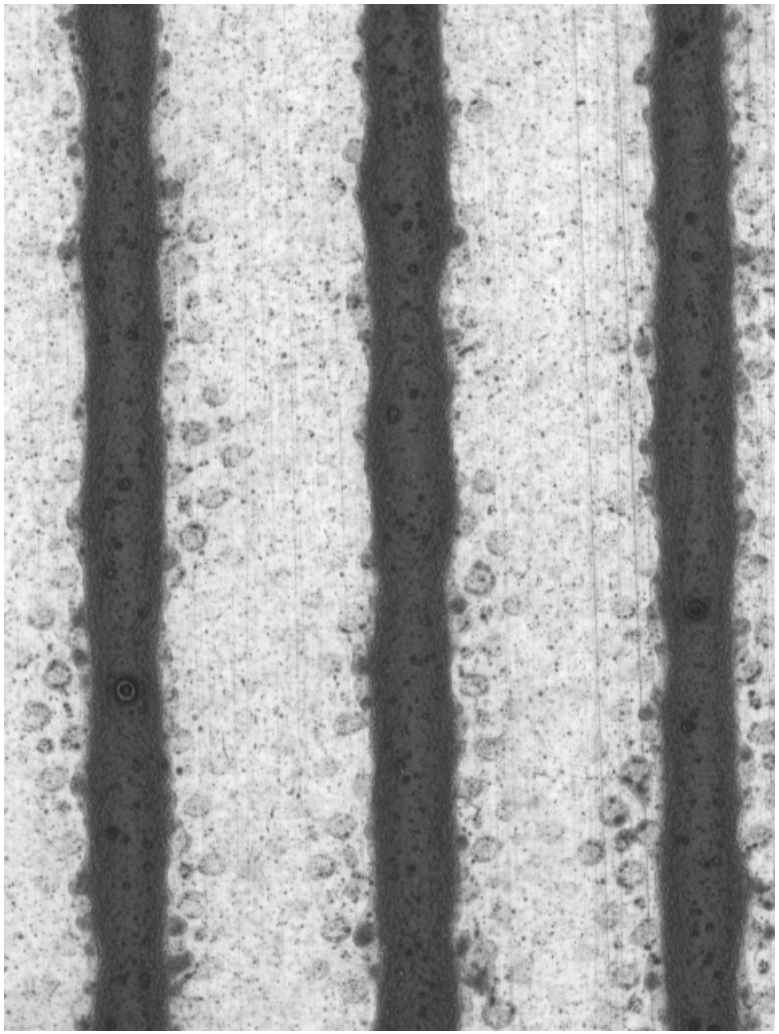
RESULT ZONE 1

- Strip of 50 µm on screen
- Result → strips of ~100 µm



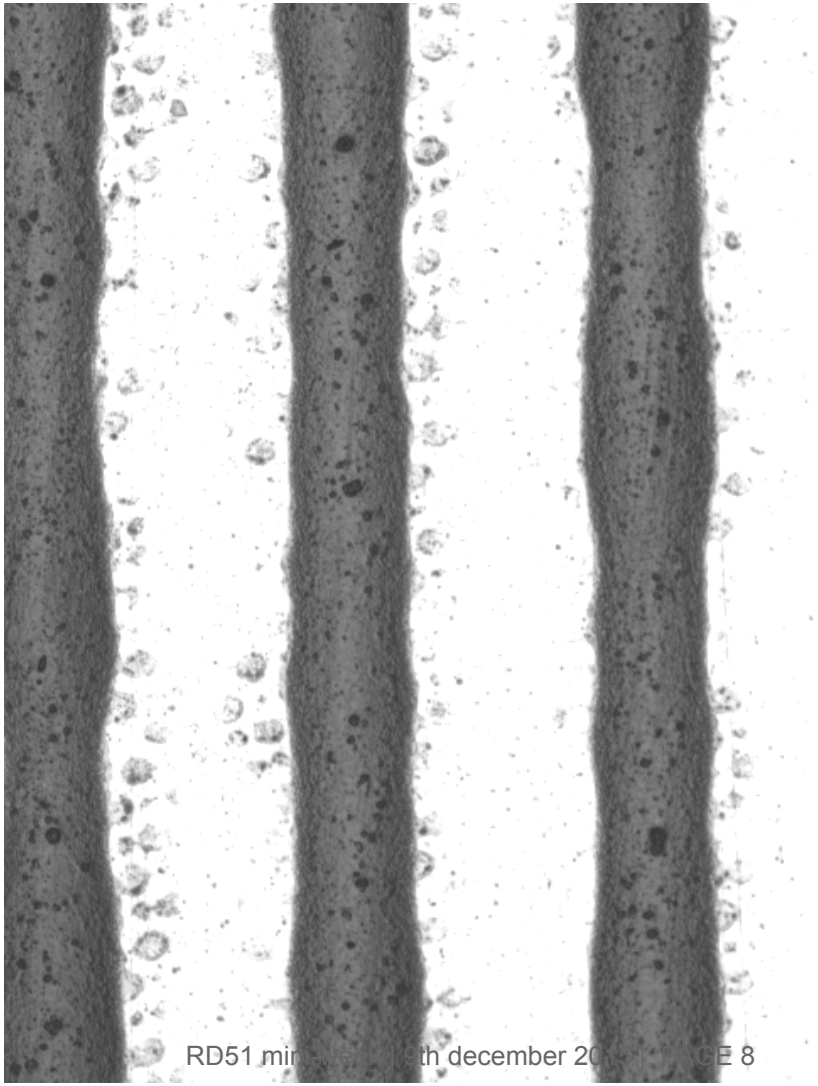
RESULT ZONE 2

- Strip of 100 µm on screen
- Result → strips of ~153 µm



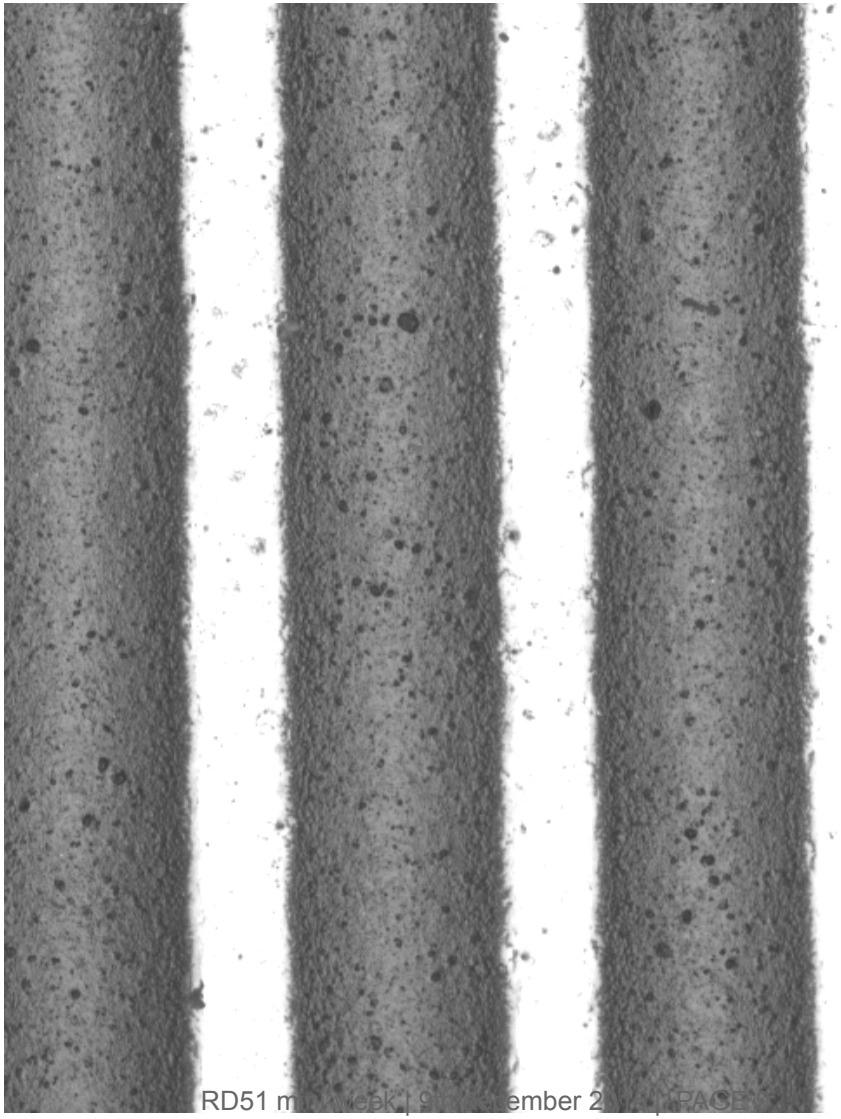
RESULT ZONE 3

- Strip of 150 µm on screen
- Result → strips of ~275 µm
- Thickness: 22 µm



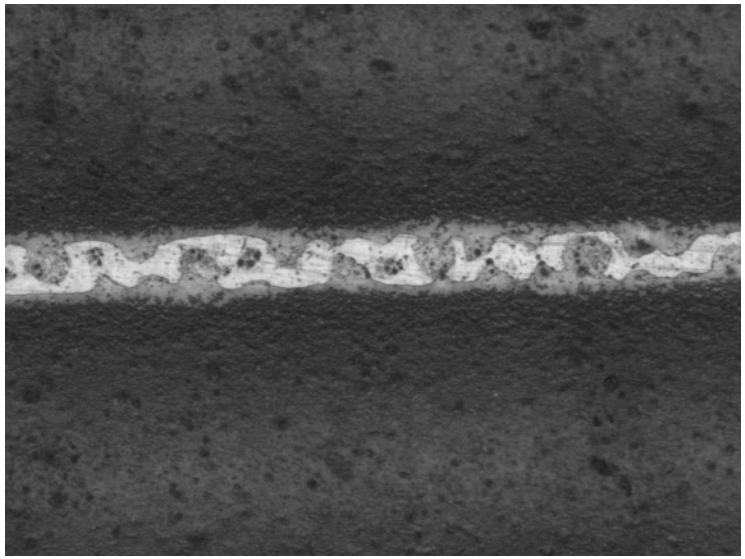
RESULT ZONE 6

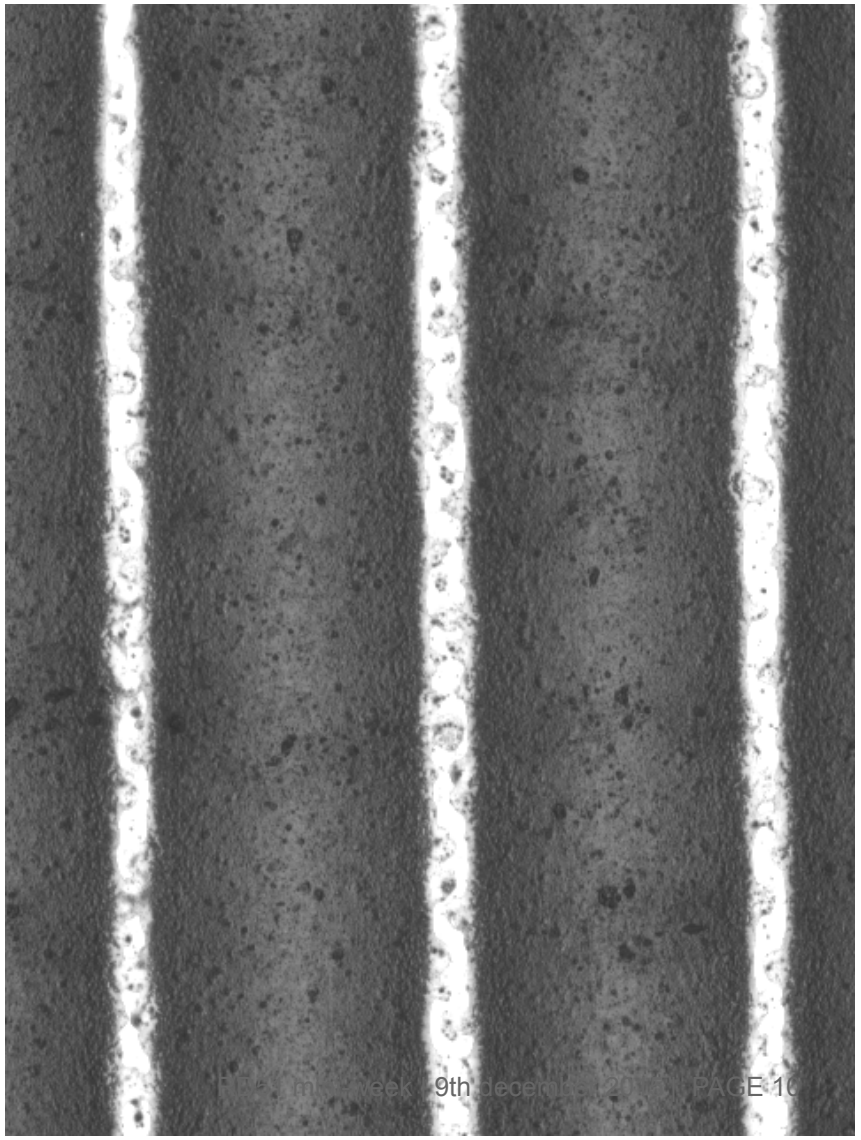
- Strip of 300 µm on screen
- Result → strips of ~482 µm
- Thickness: 36 µm



RESULT ZONE 9

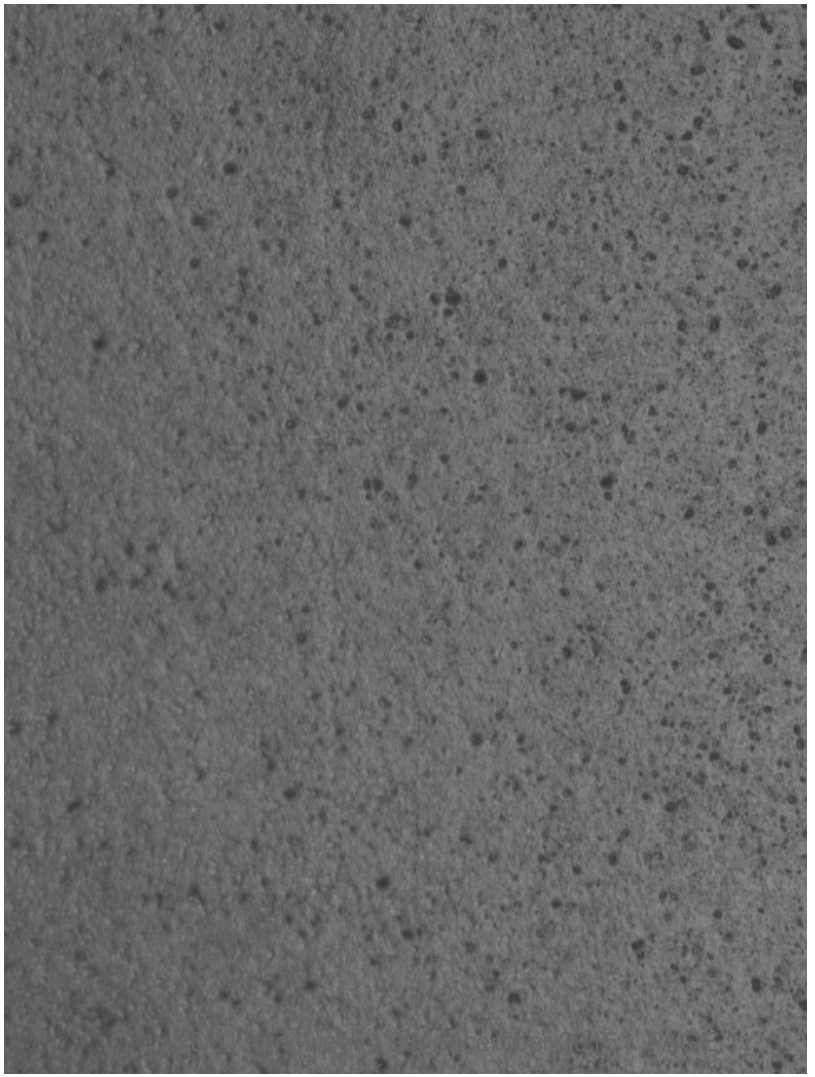
- Strip of 450 µm on screen
- Result → strips of ~630 µm

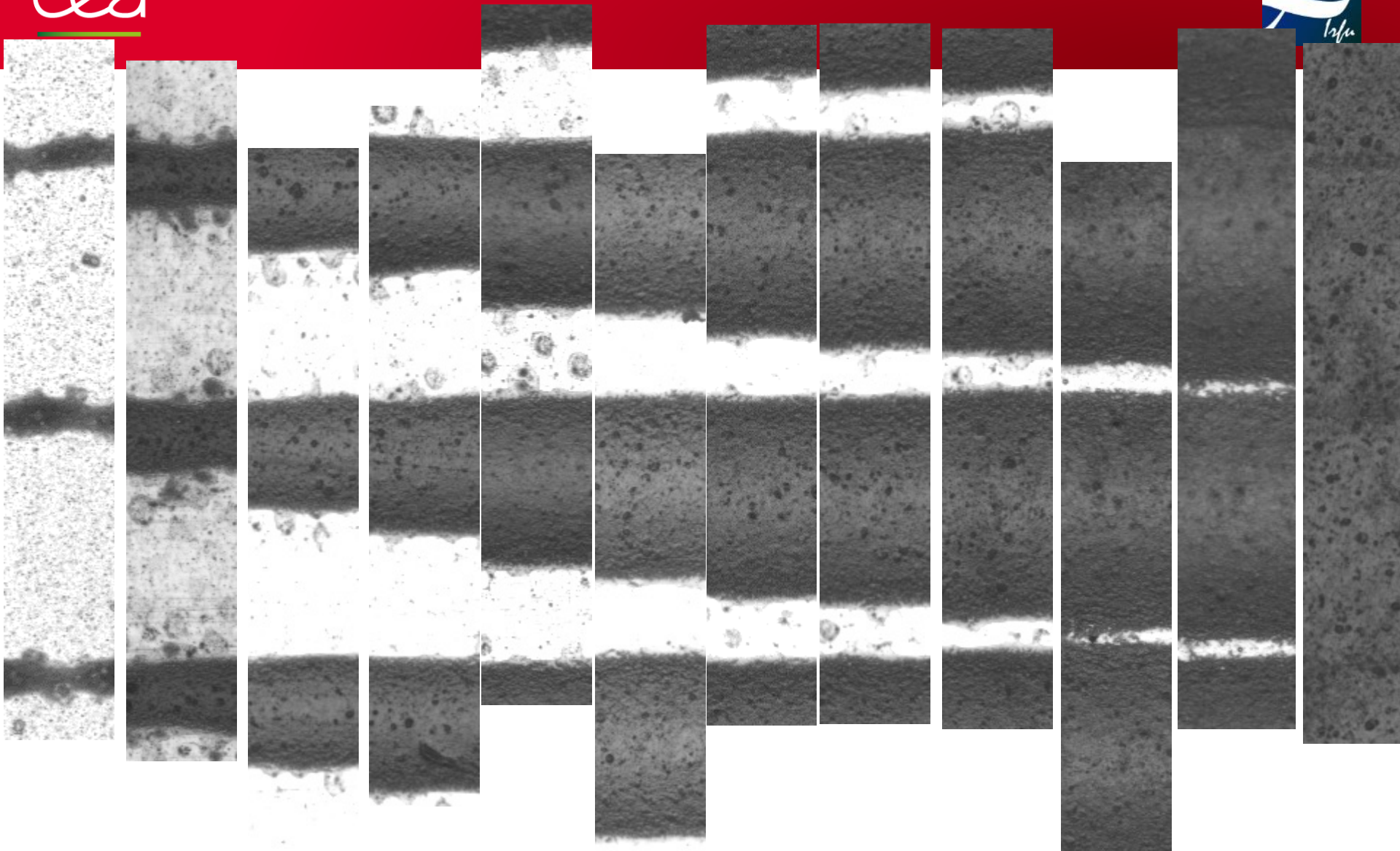




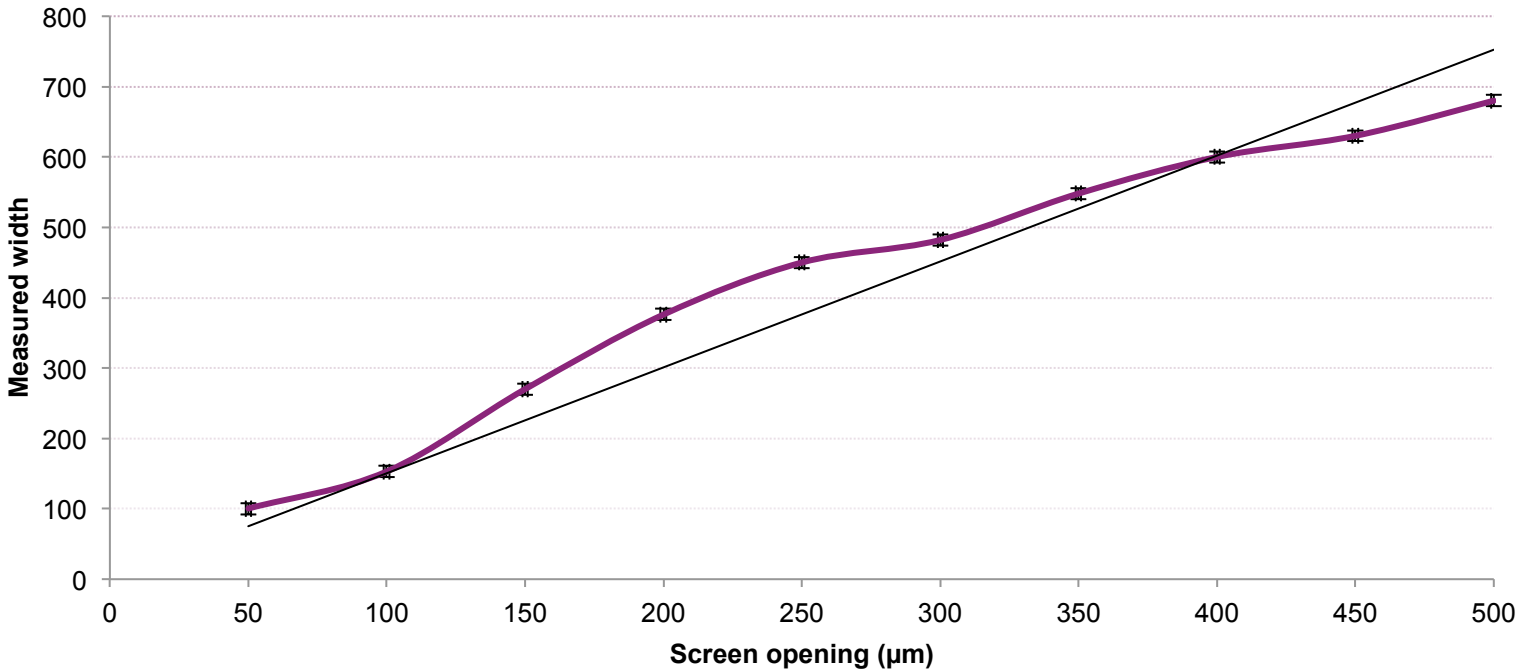
RESULT ZONE 13

- Strip of 650 µm on screen (inter = 50 µm)
- Result → plain resistive layer
- Thickness: ~ 51 µm




Z1
Z2
Z3
Z4
Z5
Z6
Z7
Z8
Z9
Z10
Z11
Z12

STRIPS METROLOGY



- With this very first test we were able to print strips of 500 mm length very uniform.
- The ratio of measured strip-size over screen opening is ~ 1,5

NEXT STEPS

- ❑ Serigraphy + resistivity measurements
- Two dedicated screens (different mesh down to SCS 45/18) with long strips + pads for resistivity measurement
- Resistivity versus temperature

- ❑ TF1O- R prototype (Active area 12x12 cm, 128 channels)
- Several resistive coating (strip, plain, mesh, pixel) will be tested:
  - Serigraphy
  - Metrology
  - resistivity measurement
  - Bulk
  - test with Fe55 and cosmic bench

- ❑ Large 2D prototype (500 mm * 500 mm) with different deposition pattern.