DE LA RECHERCHE À L'INDUSTRIE

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R&D ON RESISTIVE TECHNOLOGY FOR MICROMEGAS BUKL

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Irfu

GOAL: SCREEN PRINTING

Saclay MPGD workshop realizes Micromegas bulk detector since 3 years (~ 150 bulk).

In 2014 the workshop was upgraded with a serigraphy machine in order to manufacture resistive layer on top on PCB before the bulk process.

Goal of the serigraphy @ Saclay:

- Find the ad hoc process to make thin strips (thin inter strips, < 100 µm) on large surface (600 mm x 600 mm)
- Realize detector for IRFU experience with nominal resistive strips
- Make R&D with different patterns of resistive coating (strips, plain layer, pad,…)
- Make R&D with different resistive paste (dilution or carbon adding)
- Make R&D with use of insulating paste and/or silver conductive paste

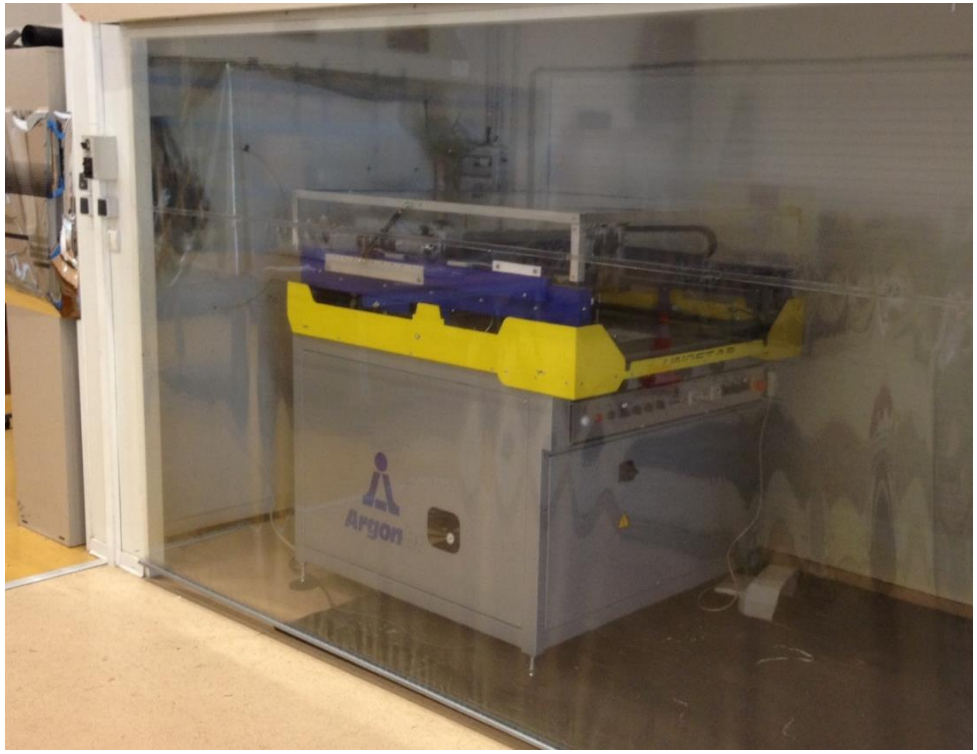
This new machine coming in addition to bulk workshop and several detector test benches in the same geographic place will allow us to make R&D iteration on resistive technology.

MACHINE

The Argon Unostar E serigraphy machine is a professional tool well suited to the type of resistive polymer to be used. The investment is ~ 30 k€ (ANR Splam)

The maximum possible area is 700 mm * 700 mm

End 2014 a first test was done with a demonstration screen with serval pattern. The goal was a training of the IRFU technician with serigraphy professional.



TEST PARAMETER

- Screnn:
  - Mesh stainless steel inox M325, SD90/40 at 15°
  - ENDUCTION on screen of 6-8µ (measure = 8 µm)
  - Theoretical thickness of paste deposition ~ 48 µm
  - measure tension of the screen mash = 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

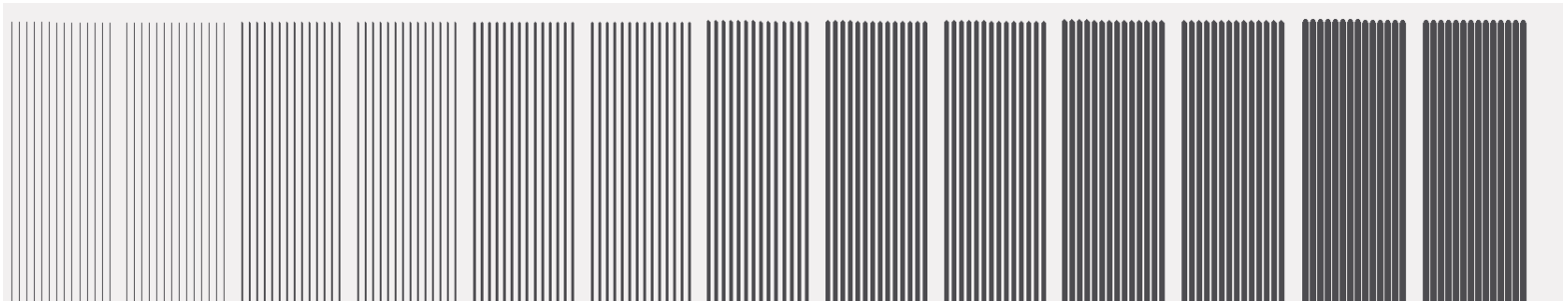
- Parameters of machine Argon Unostar E:
  - hors contact" minimum,
  - Average speed,
  - Average pressure

TEST SCREEN

The test screen had serval type of strip 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 seize 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



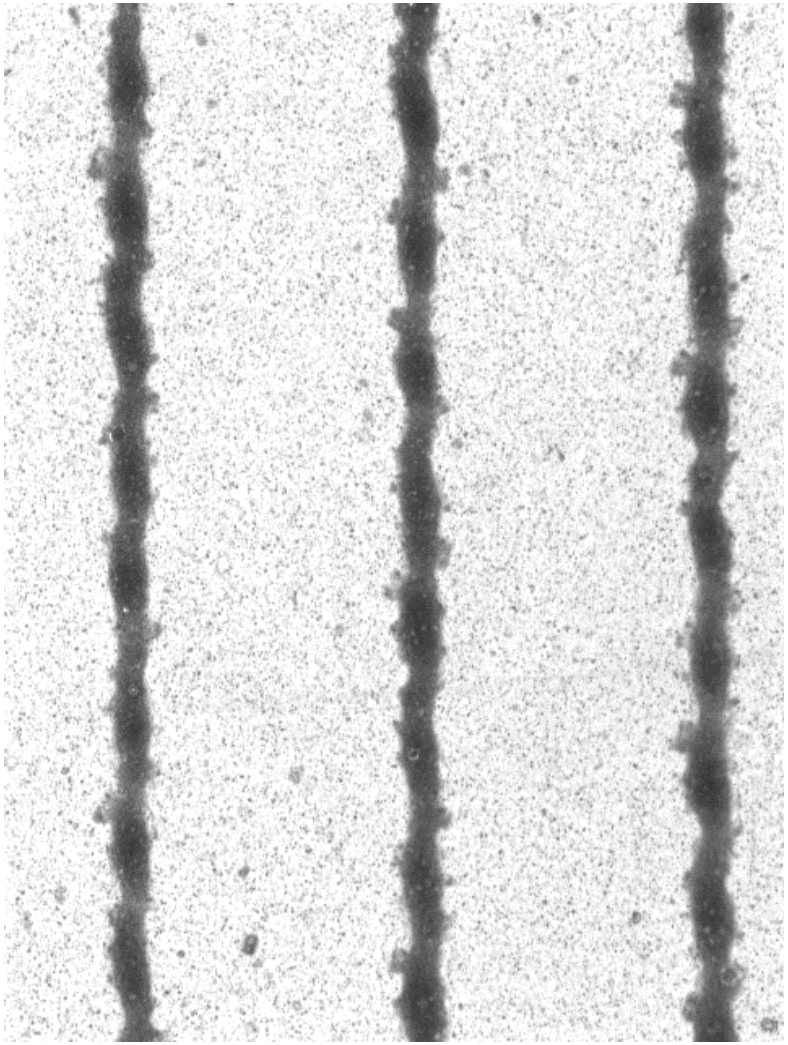
Zone 1

Zone 13

RESULT ZONE 1

Strip of 50 µm on screen

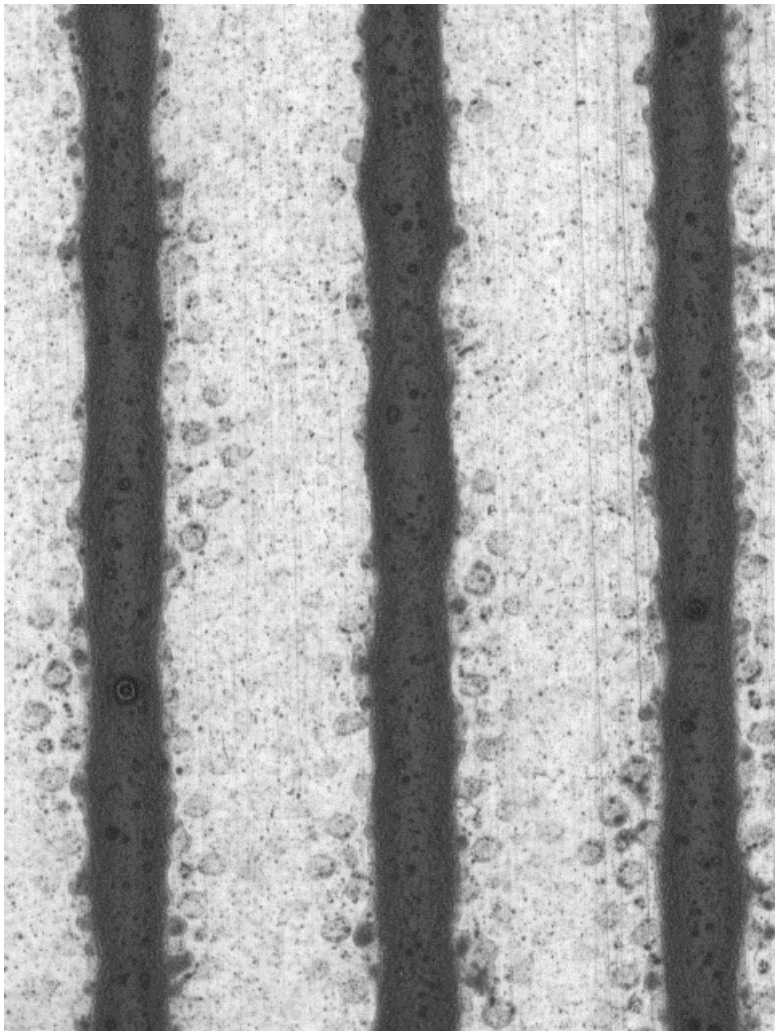
Result = strips of ~100 µm



RESULT ZONE 2

Strip of 100 µm on screen

Result = strips of ~153 µm

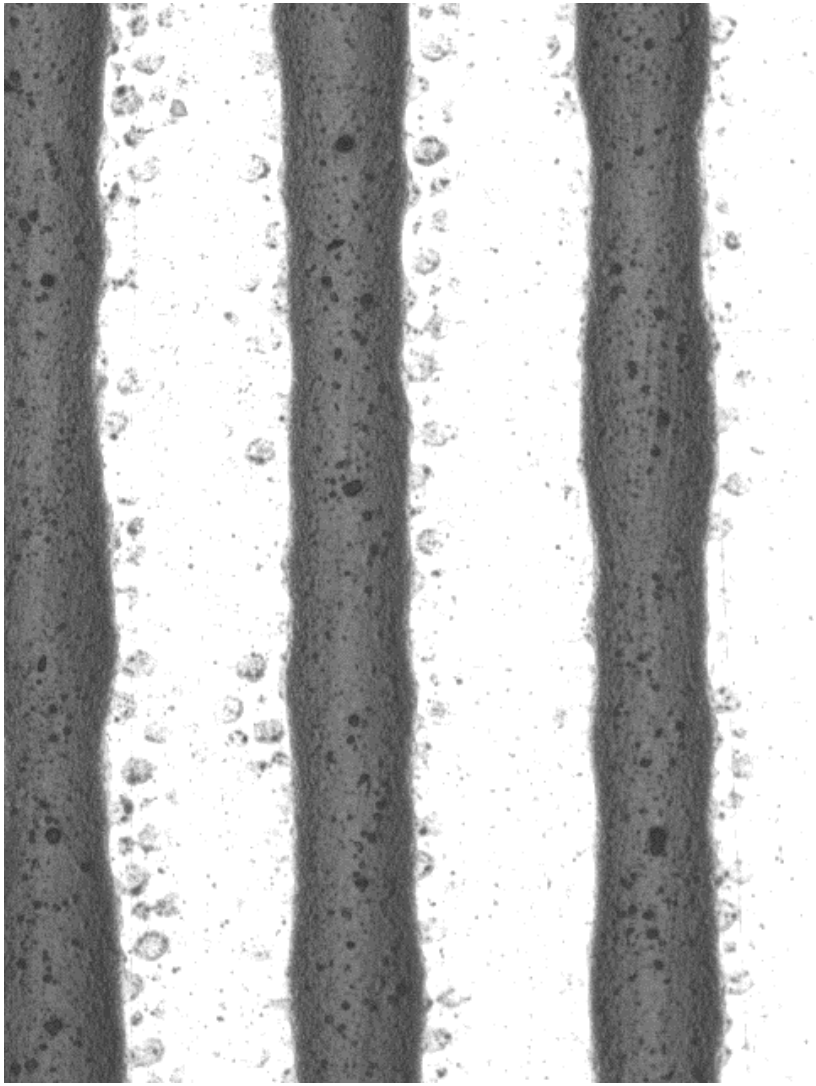


RESULT ZONE 3

Strip of 150 µm on screen

Result = strips of ~275 µm

Thickness: 22 µm

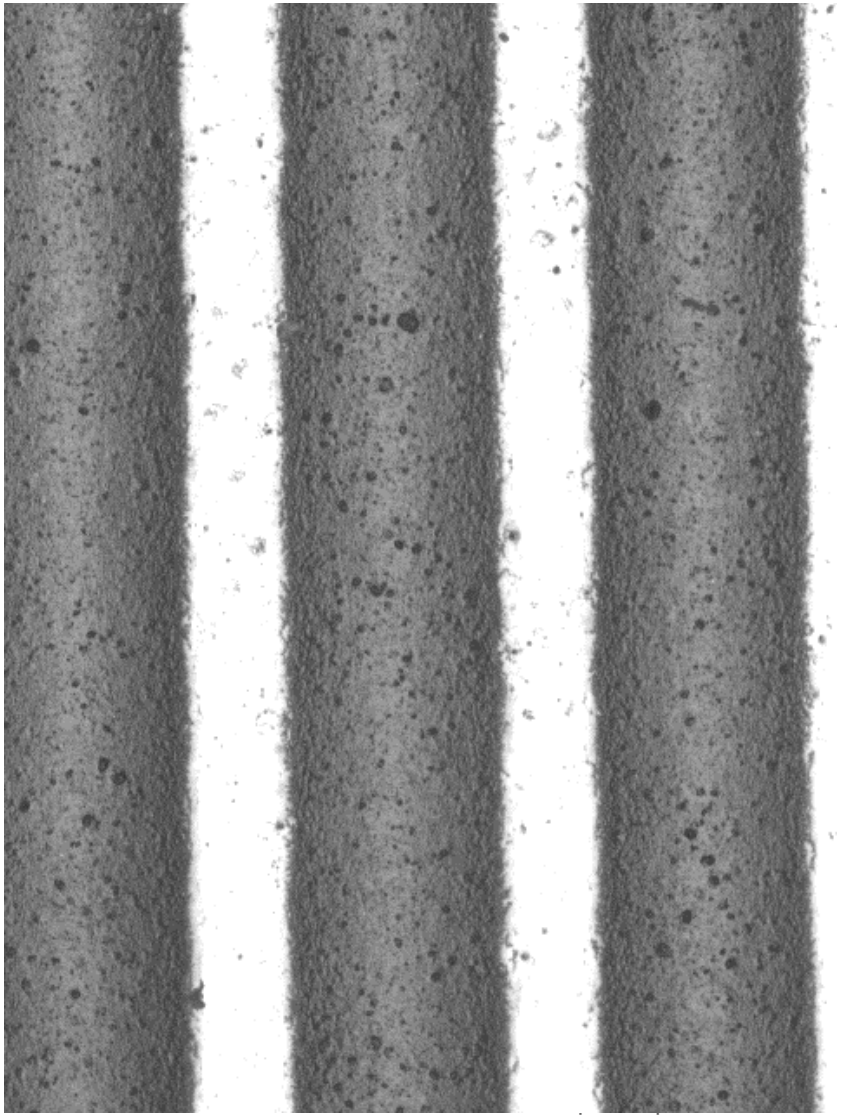


RESULT ZONE 6

Strip of 300 µm on screen

Result = strips of ~482 µm

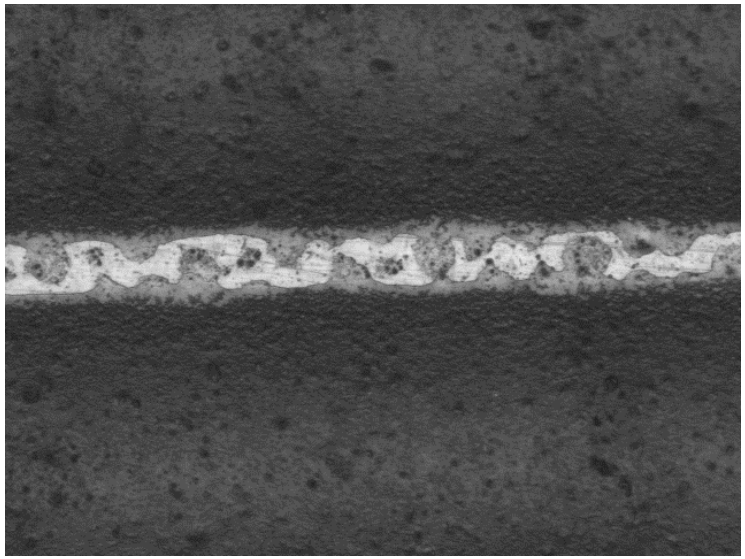
Thickness: 36 µm

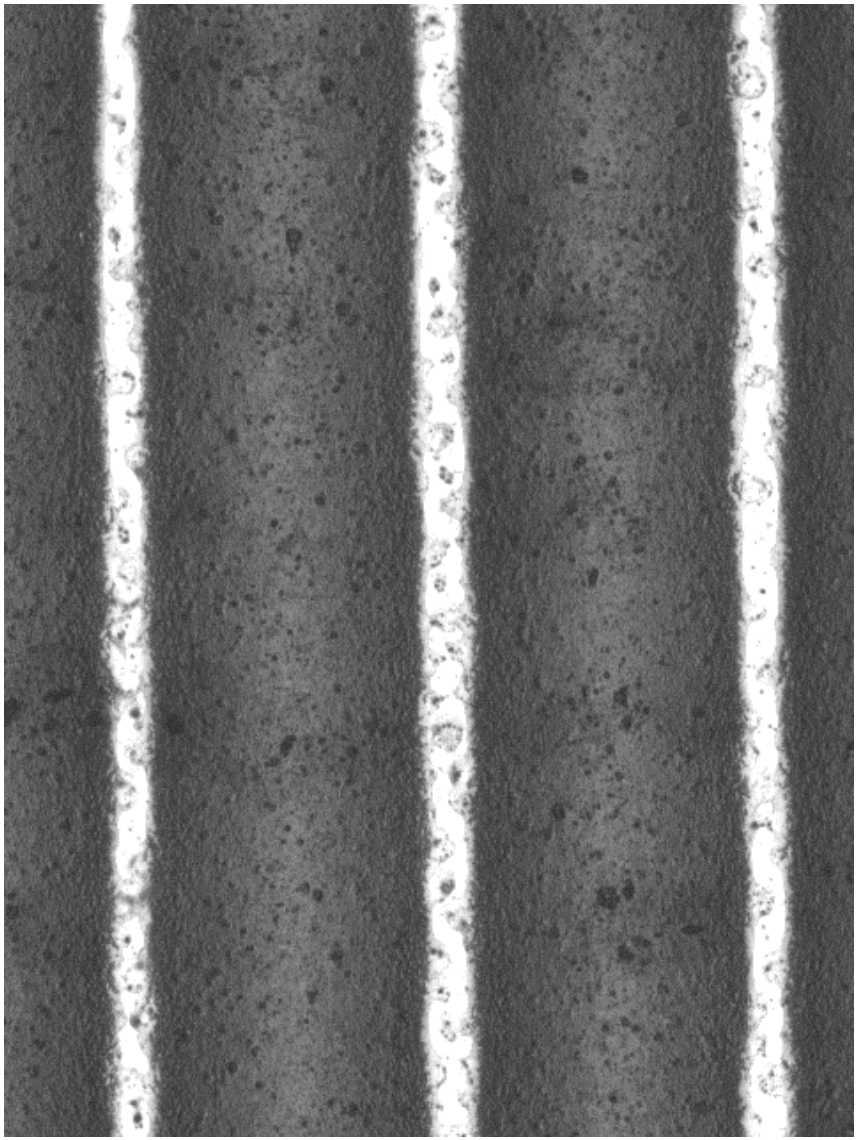


RESULT ZONE 9

Strip of 450 µm on screen

Result = strips of ~630 µm



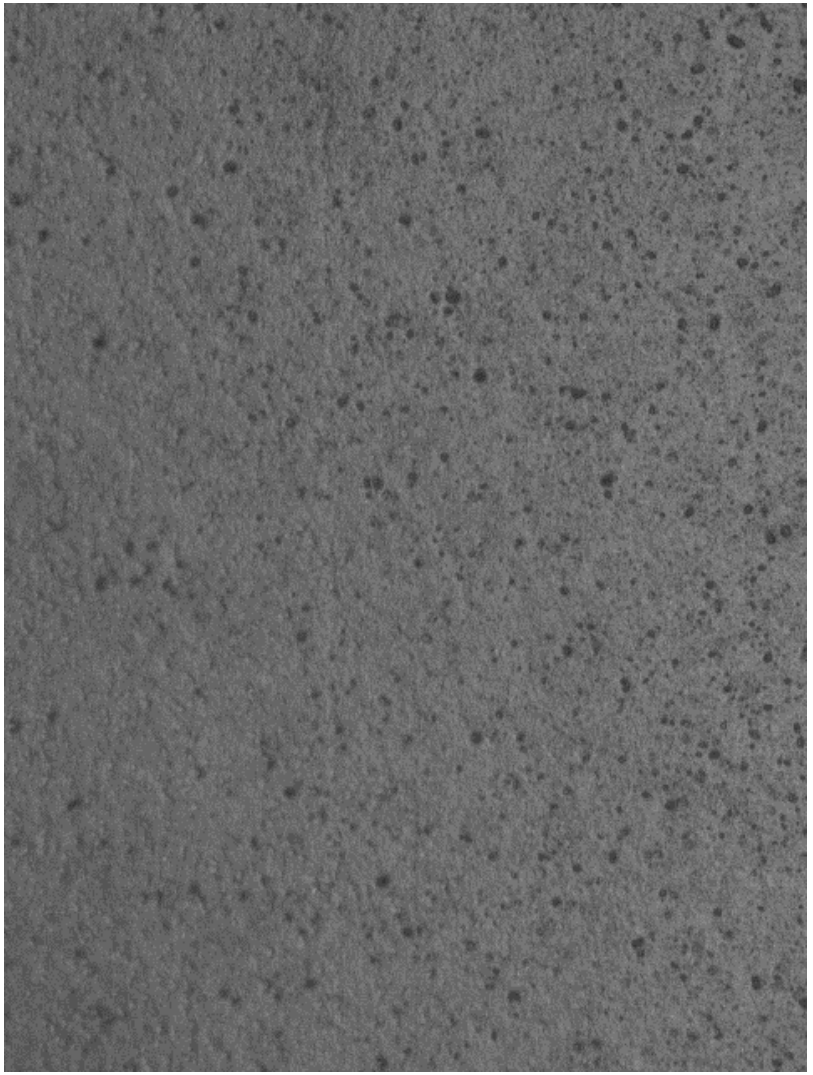


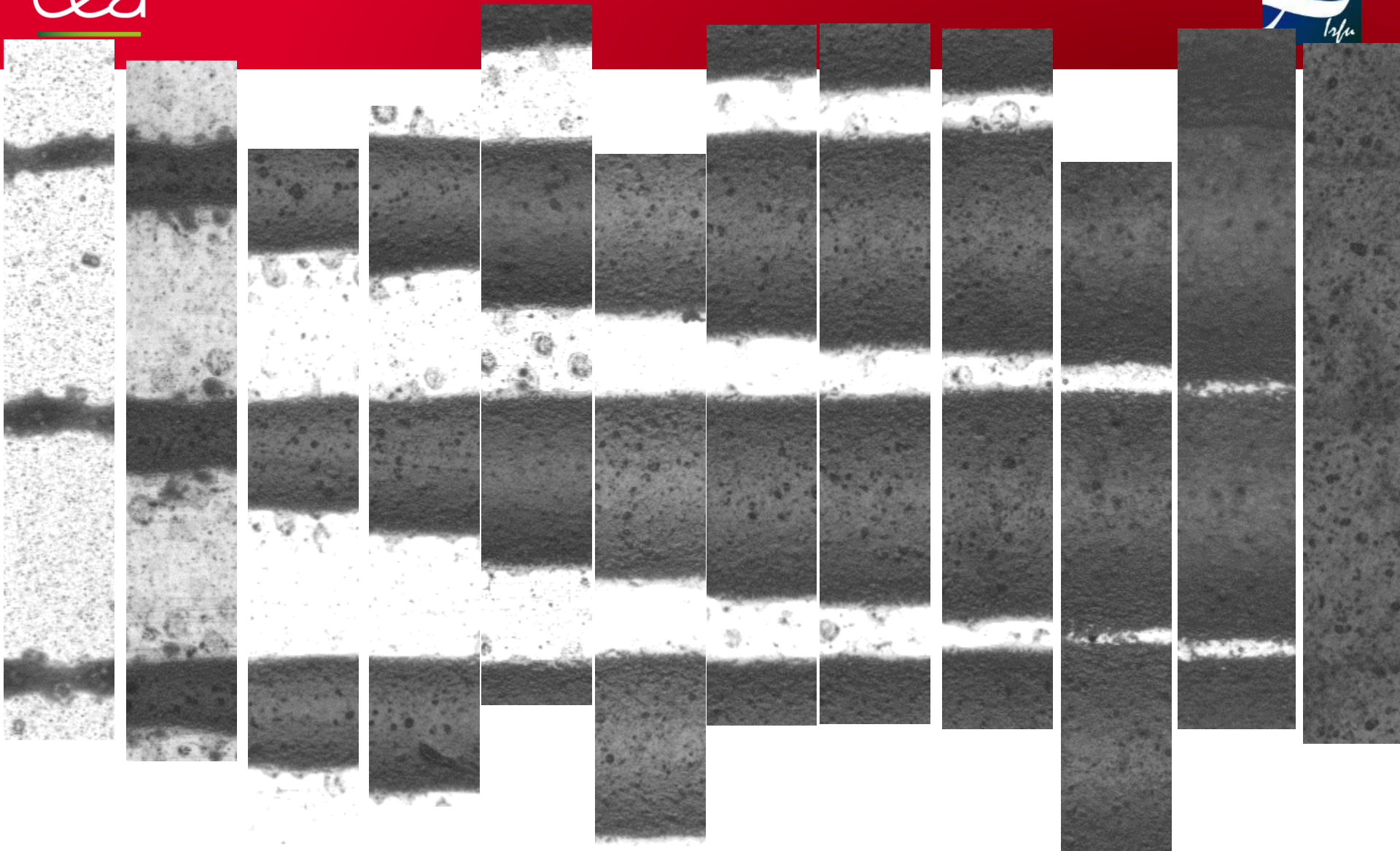
RESULT ZONE 6

Strip of 650 µm on screen (inter = 50 µm)

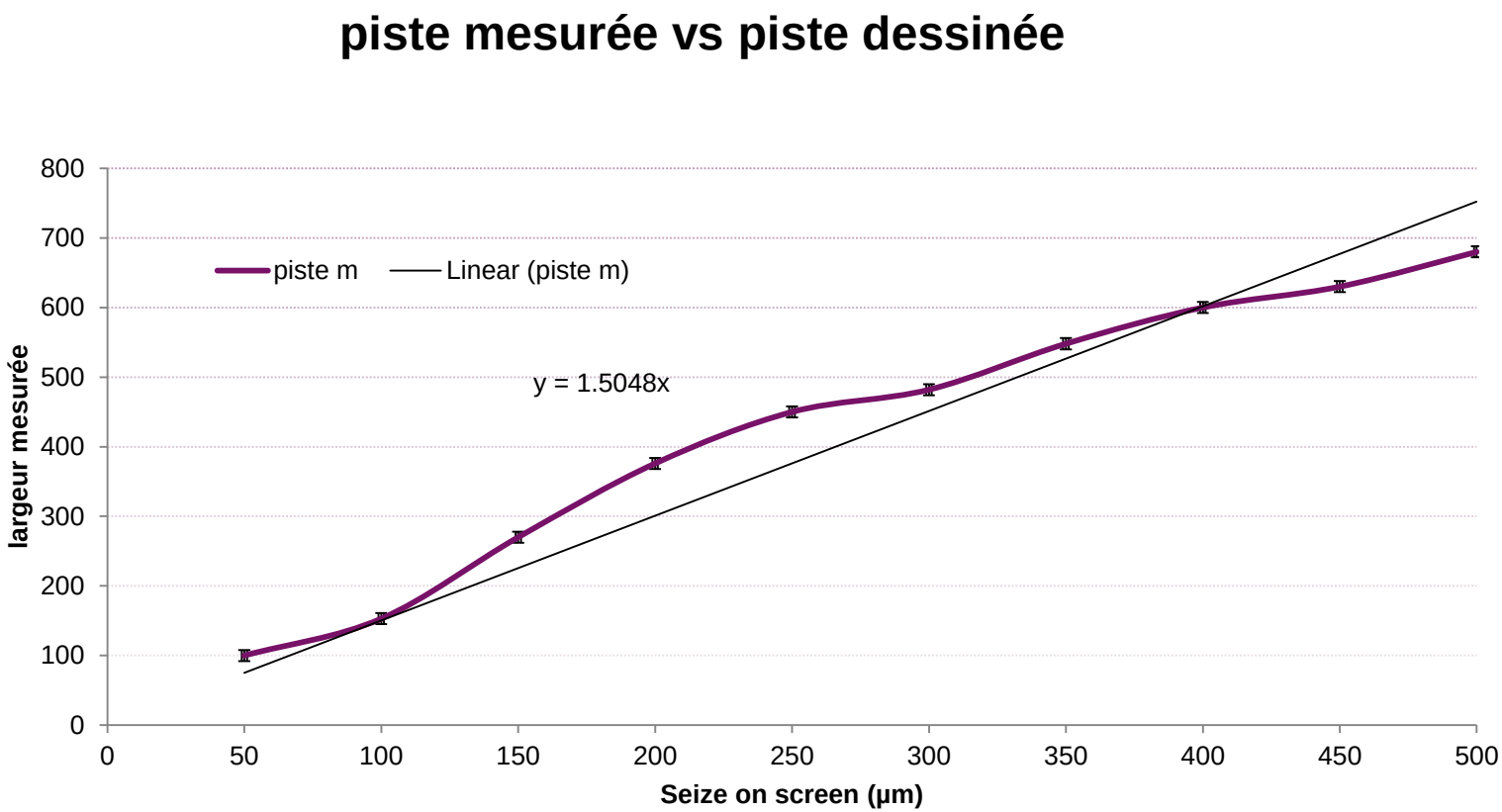
Result = plain resist

Thickness: ~ 51 µm




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

STRIPS METROLOGY



With this very first test we where able to print strips of 500 mm length very uniform.

The seize of the strip can be adjusted by the seize of the screen opening (ratio ~ 1,5)

FURTHER TEST: SUMMER/FALL 2015

Serigraphy + resistivity measurement

- Two dedicated screens (different mesh down to SCS 45/18) with long strips + pads for resistivity measurement
- backing test (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.

R&D ON THIN MESH

A other R&D at Saclay workshop: **Thin mesh bulk**

Paris Saclay University funding for R&D: call for ~60 k€

Goal : find a process to allow bulk manufacturing with thin mesh

- Serval type of mesh will be tested on 12x12 cm²
  - Copper mesh (Rui)
  - electroformed mesh
  - woven mesh with extra lamination

In order to find the ad hoc amplification gap versus the pressure (0 to 4 bar), we will realize a small Micromegas setup (4 mm anode = no pillars) allowing a scanning of the gap from 20 µm to 500 µm by steps of 10 µm. Serval meshes will be tested.

For 2016: Prototype of 30x30 cm² using thin mesh

For 2017: Harpo TPC prototype (thin mesh at high pressure Bar)