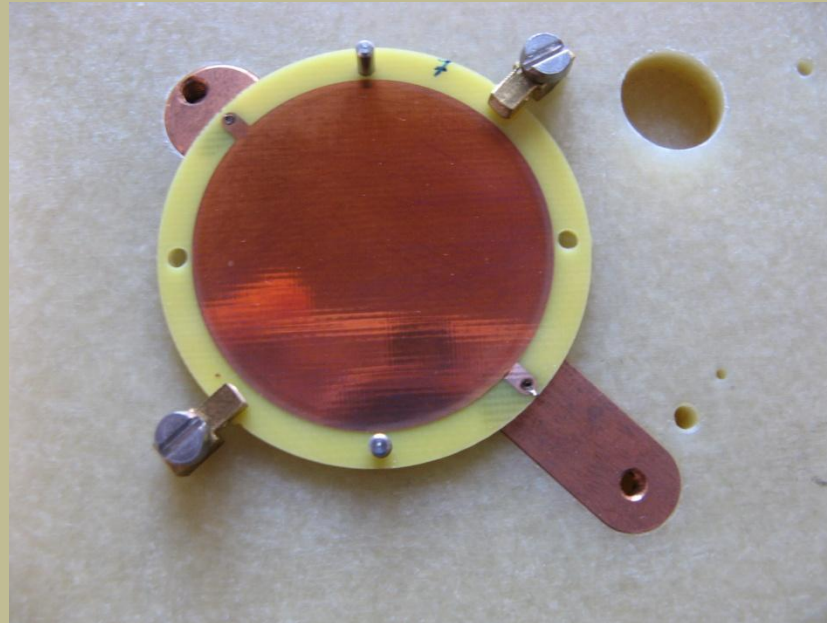


Systematic studies for microbulk detectors

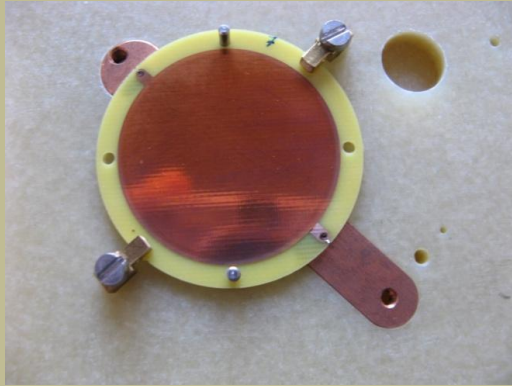
E. Ferrer Ribas, A. Giganon, Y. Giomataris, FJ Iguaz, T. Papaevangelou (Saclay)
A. Gris, R. de Oliveira (CERN)
T. Dafni, A. Tomás, I. Irastorza (Zaragoza)



Summary

- 1) Microbulks characteristics
- 2) Etching process: going further
- 3) Test bench
- 4) Measurements in gas (Ar+5%C₄H₁₀)
 - Electron transmission
 - Gain
 - Energy resolution
- 5) Summary of results
- 6) Conclusion

1) Microbulks characteristics



Fabrication at Rui's workshop

1) Double sided Cu-coated (5 μm)
polyimide Kapton foil (50 μm)



2) Photochemical production
of mesh holes



3) Polyimide Kapton etching



Three types of Microbulks will be presented (gap mesh/anode: 50 μm)

1) Standard Microbulk

(typical capacitance: < 480 pF)

holes diameter: 37 μm

pitch: 100 μm

2) Etched Microbulk

(typical capacitance: < 410 pF)

3) Microbulk with pillars

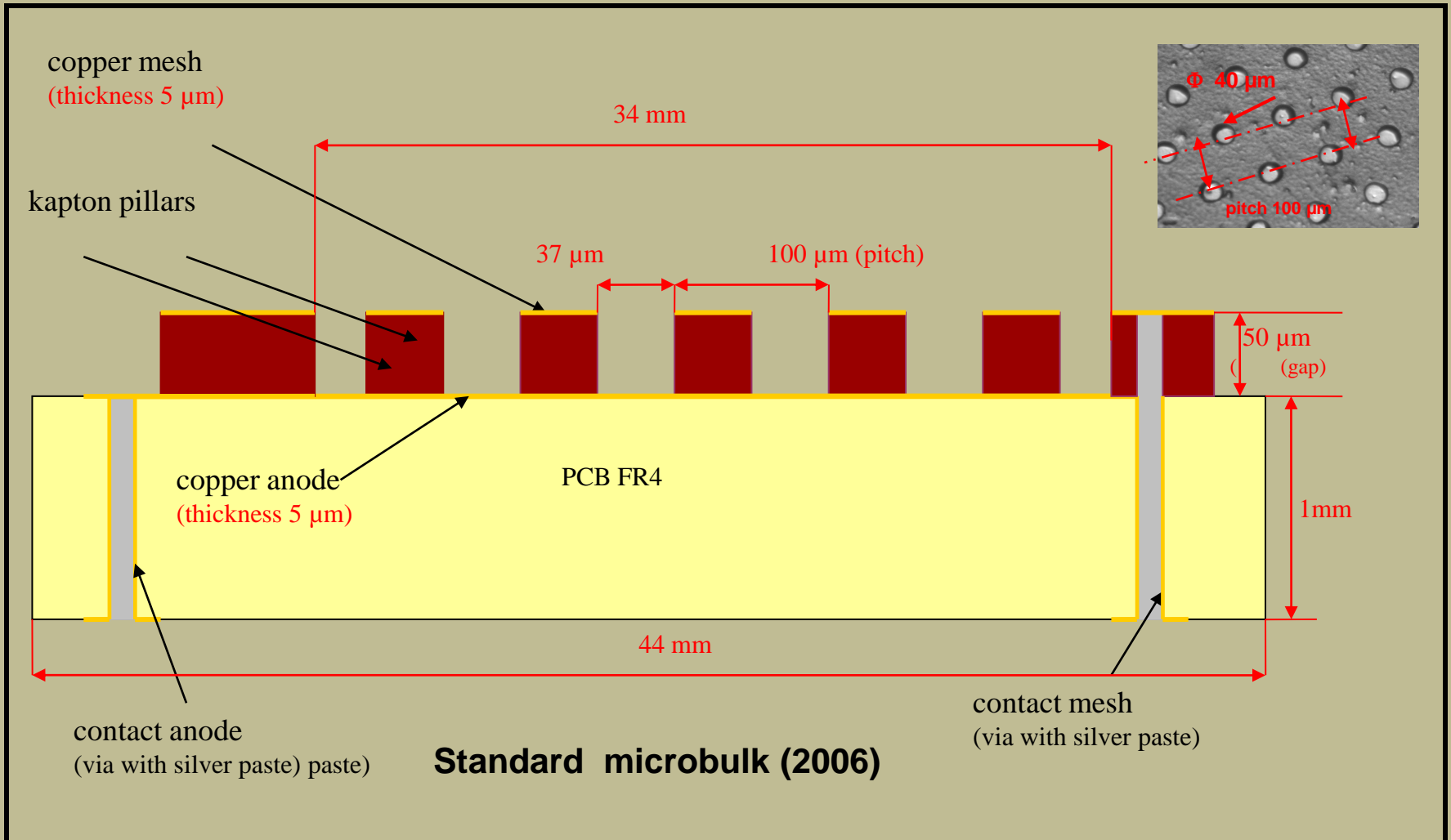
(pitch pillars: 0.5 and 1mm)

Diameter pillar: 200 μm

(typical capacitance: < 240 pF)

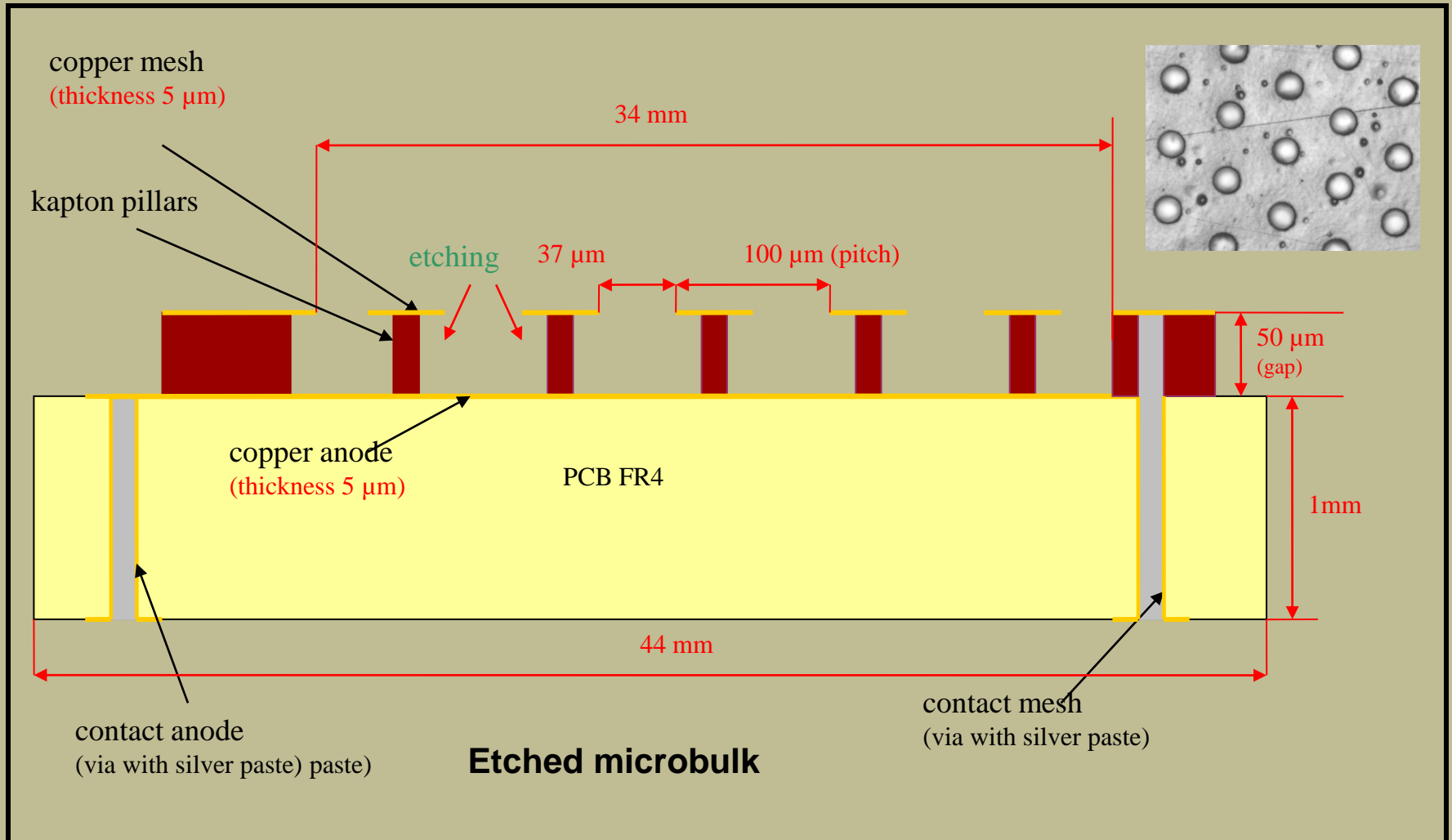
Characteristics

Standard microbulk (2006)



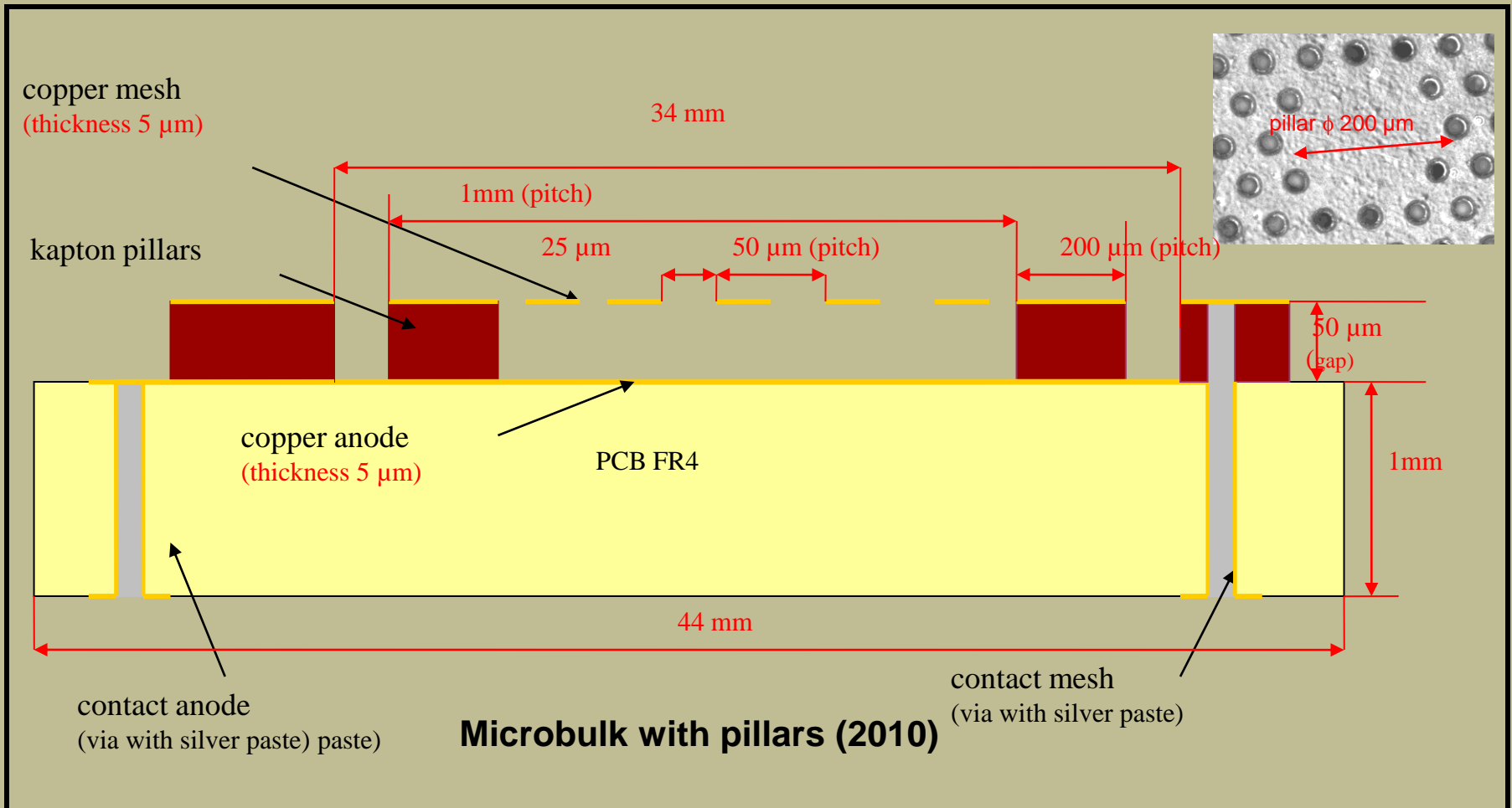
Characteristics

Etched Microbulk



Characteristics

Microbulk with pillars, 2010



Summary of Microbulks characteristics

MICROBULK TYPE	standard microbulk	etched microbulk	pillars microbulk (v1)	pillars microbulk (v2)
FABRICATION DATE	2006	2006	2008	2009-2010
SUPPORT STRUCTURE	epoxy FR4			
STRUCTURE THICKNESS	1 mm			
STRUCTURE DIAMETER	44 mm			
SENSITIVE AREA	34 mm			
GAP MESH/ANODE	50 μm			
MESH THICKNESS	5 μm			
ANODE THICKNESS	5 μm			
HOLES MESH DIAMETER	37 μm	37 μm	30 μm	25 μm
HOLES PITCH	100 μm	100 μm	60 μm	50 μm
CAPACITY	480 to 420 pF	410 to 330 pF	300 pF	240 to 180 pF
PILLARS DIAMETER			200 μm	200 μm
PILLARS PITCH			0,5 mm	1 mm

Aim of the R&D

- **Optimize detector performances in terms of maximal gain and energy resolution and decrease the capacitance (decrease the noise)**
- **Comparison of non etched / etched / Microbulks with pillars**

Measurements

- Electron transmission
- Maximal Gain
- Energy resolution (^{55}Fe)

2) Etching process at CERN

Cleaning process

- 5 microbulks : (4 cleaned) and 1 used as a reference.
- Cleaning : washing powder + deionized water at 30°C/2mn, rinsing/2mn, Nitrogen blowing then baking at 80°C/10mn.

2) Etching process at CERN

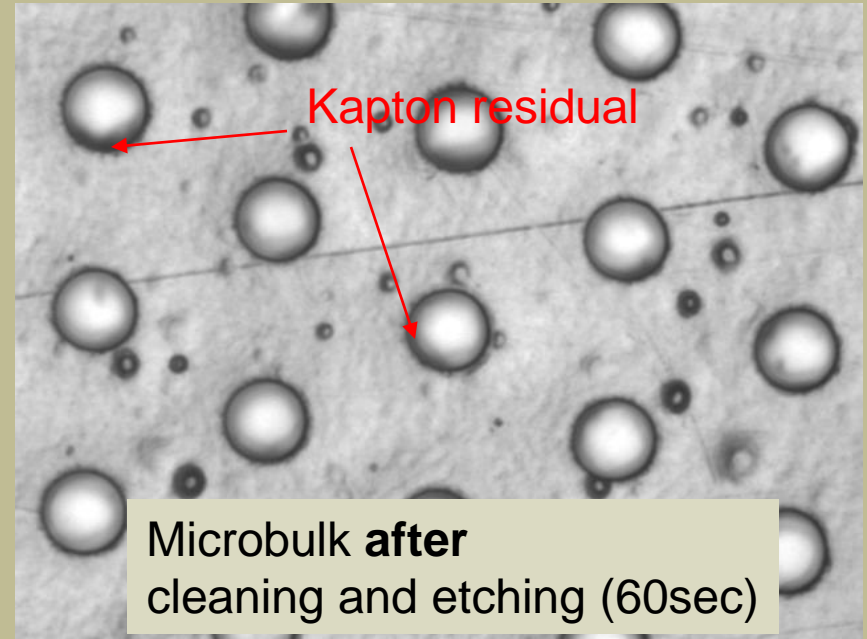
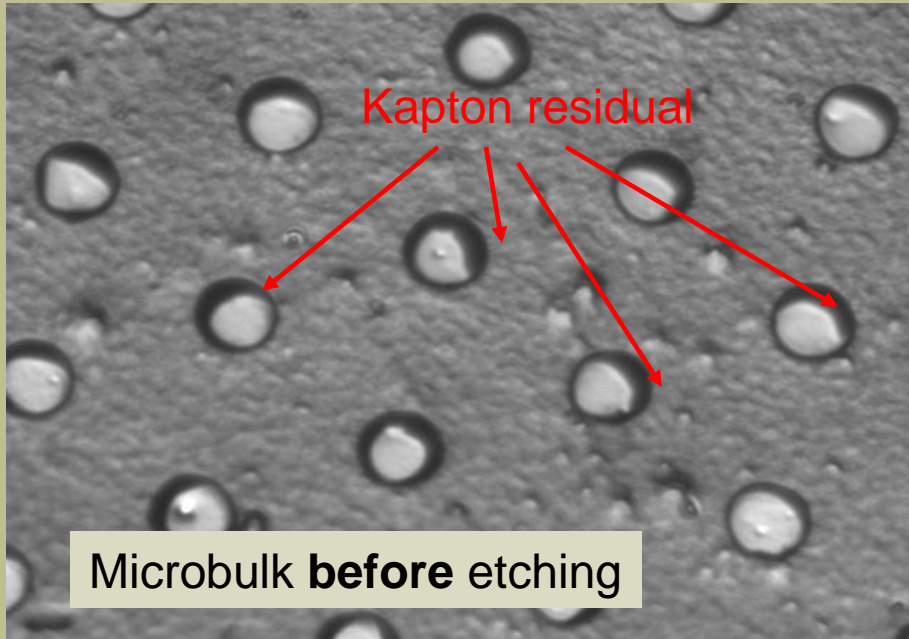
Chemical attack

- After cleaning, kapton is chemically etched in a solution at 65°C
(solution: Ethylene Diamine, with deionized water and Potassium regulated in temperature).
- 1 microbulk (M8) as reference (no etched)
 - 2 microbulks etched 30 sec
 - 1 microbulk etched 45 sec
 - 1 microbulk etched 60 sec

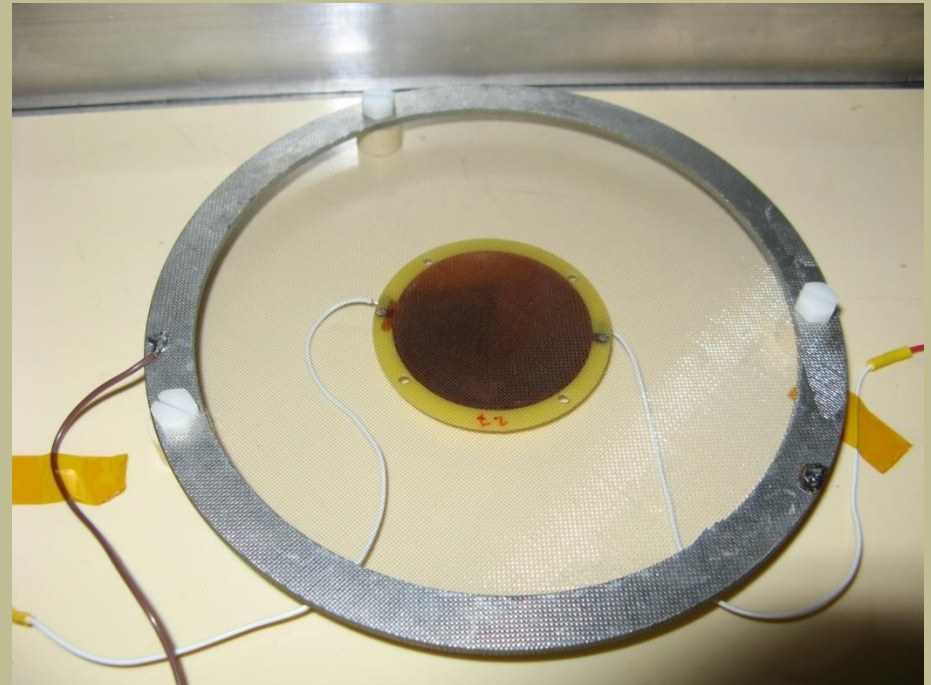
2) Etching process at CERN (pre-tests)

- Check the chemical attack (microscope)
- Capacity measurement (comparison before/after etching)
- high voltage tests in the air (check the ramp up at 600 V without residual current)

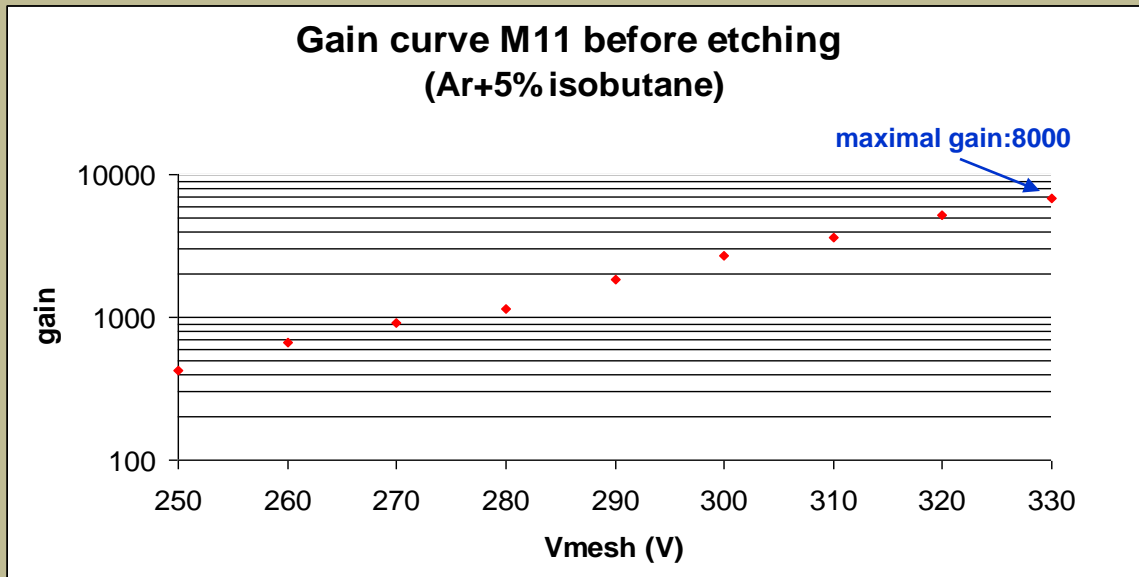
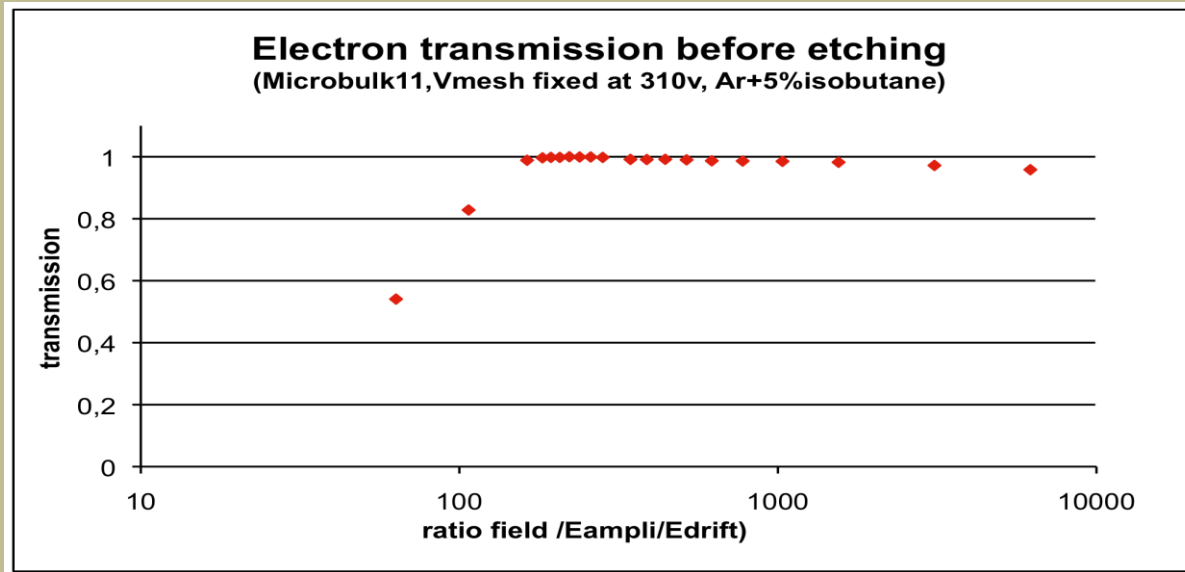
Pre-tests (check)



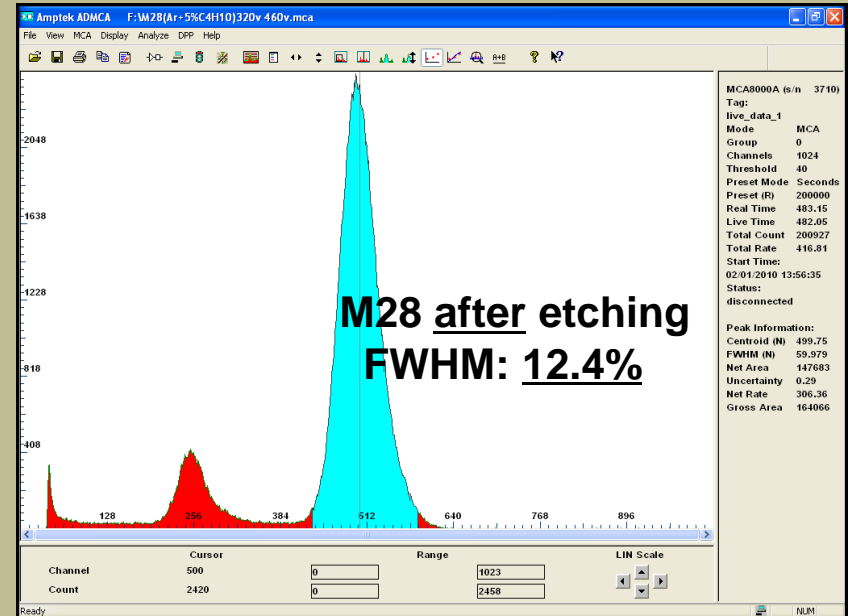
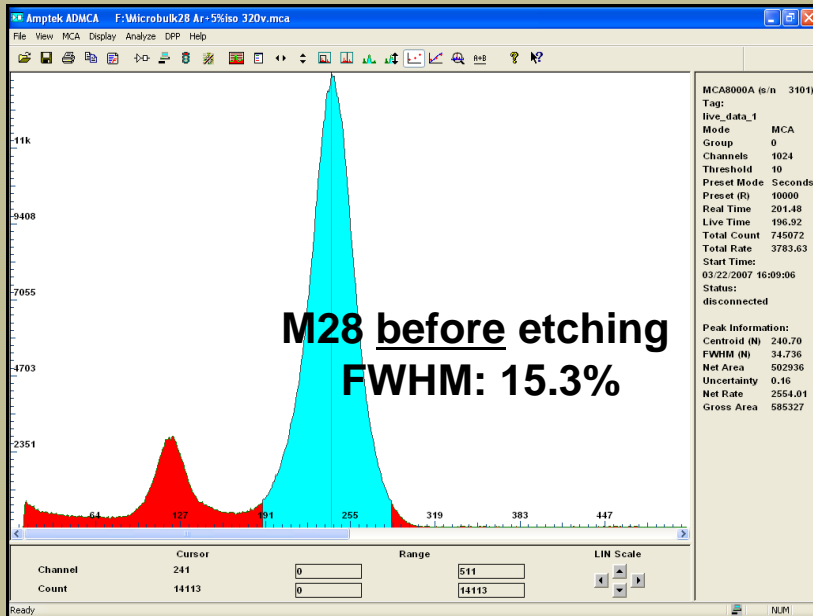
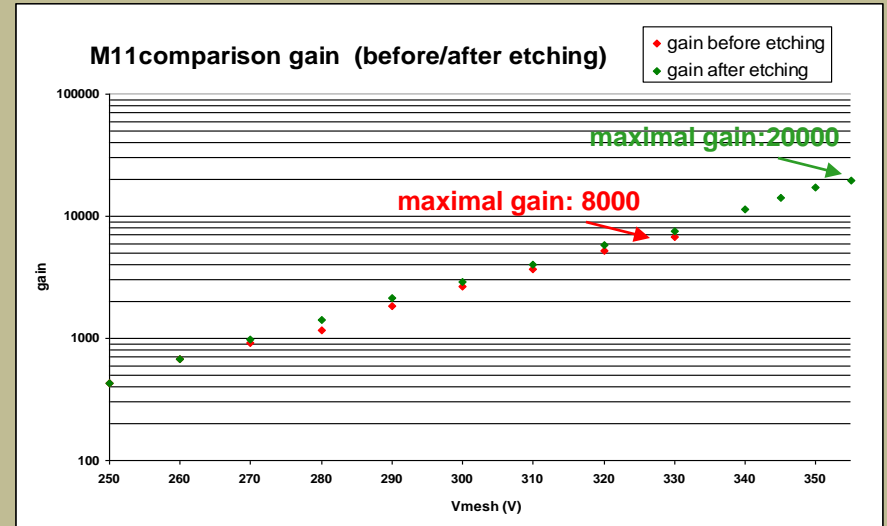
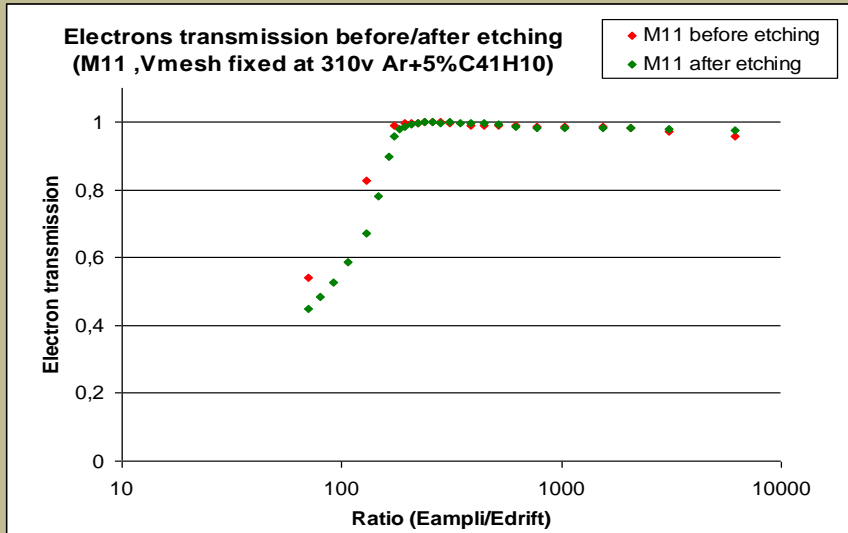
3) Test bench at Saclay



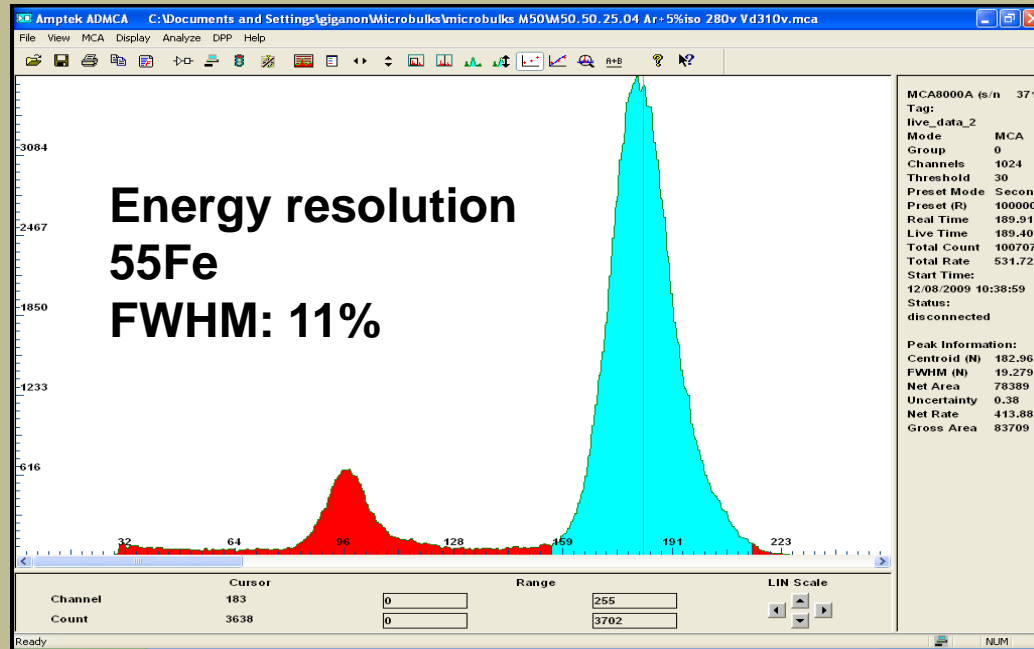
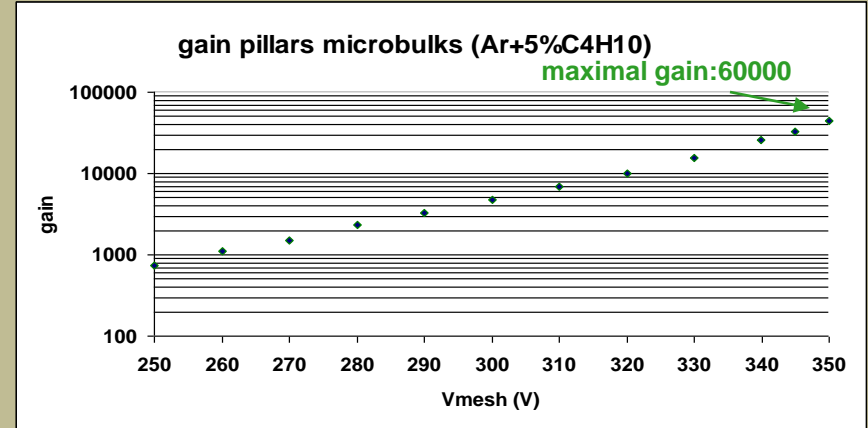
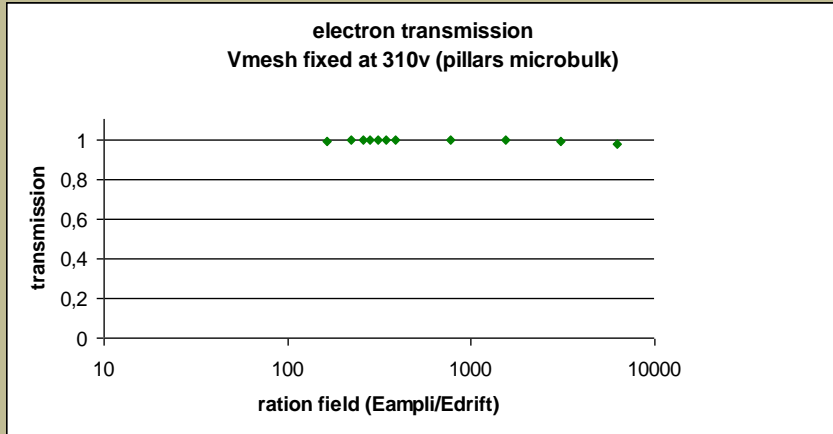
4) Measurements in gas (before etching)



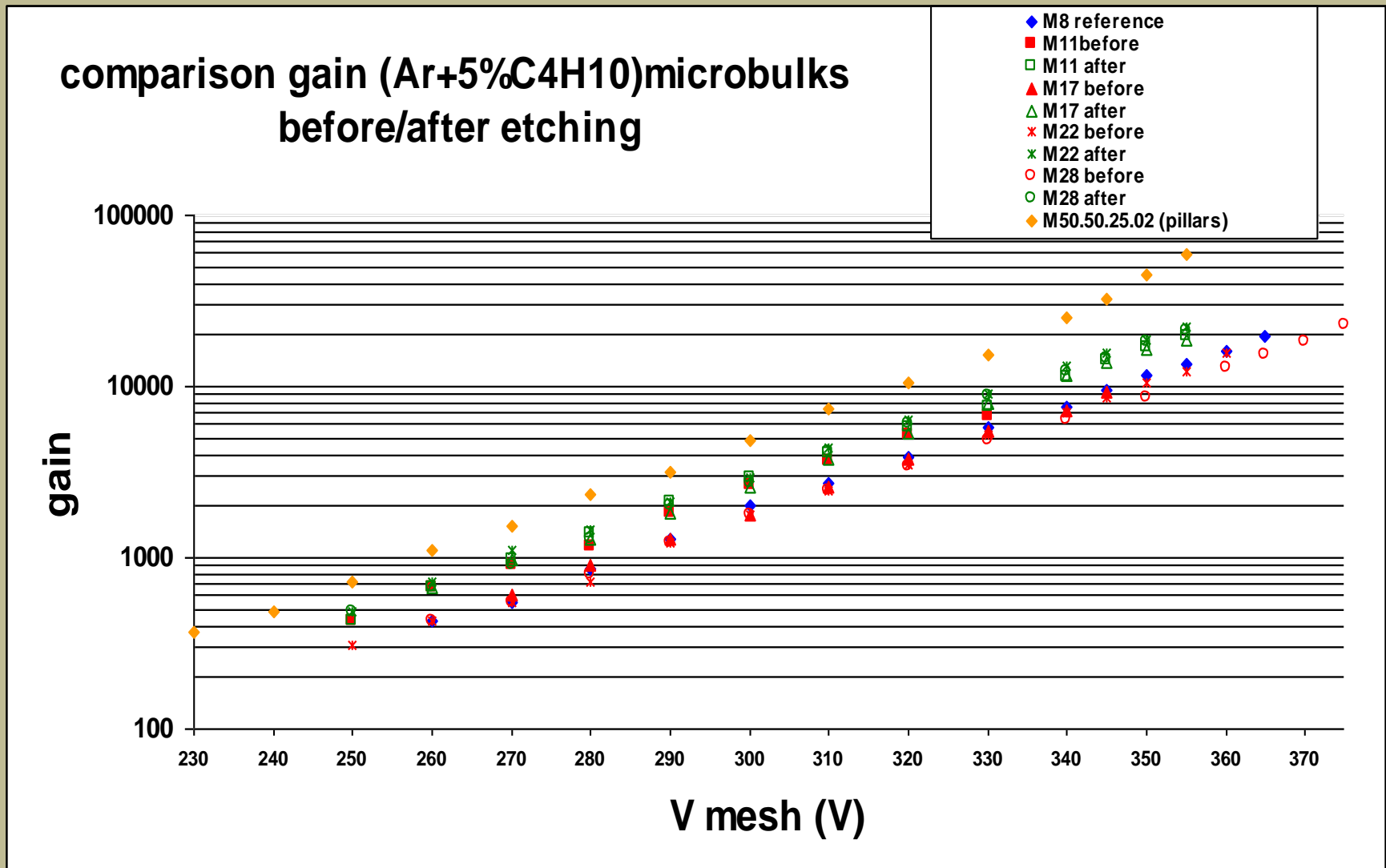
Measurements (before/after etching)



Measurements in gas (microbulks with pillars)

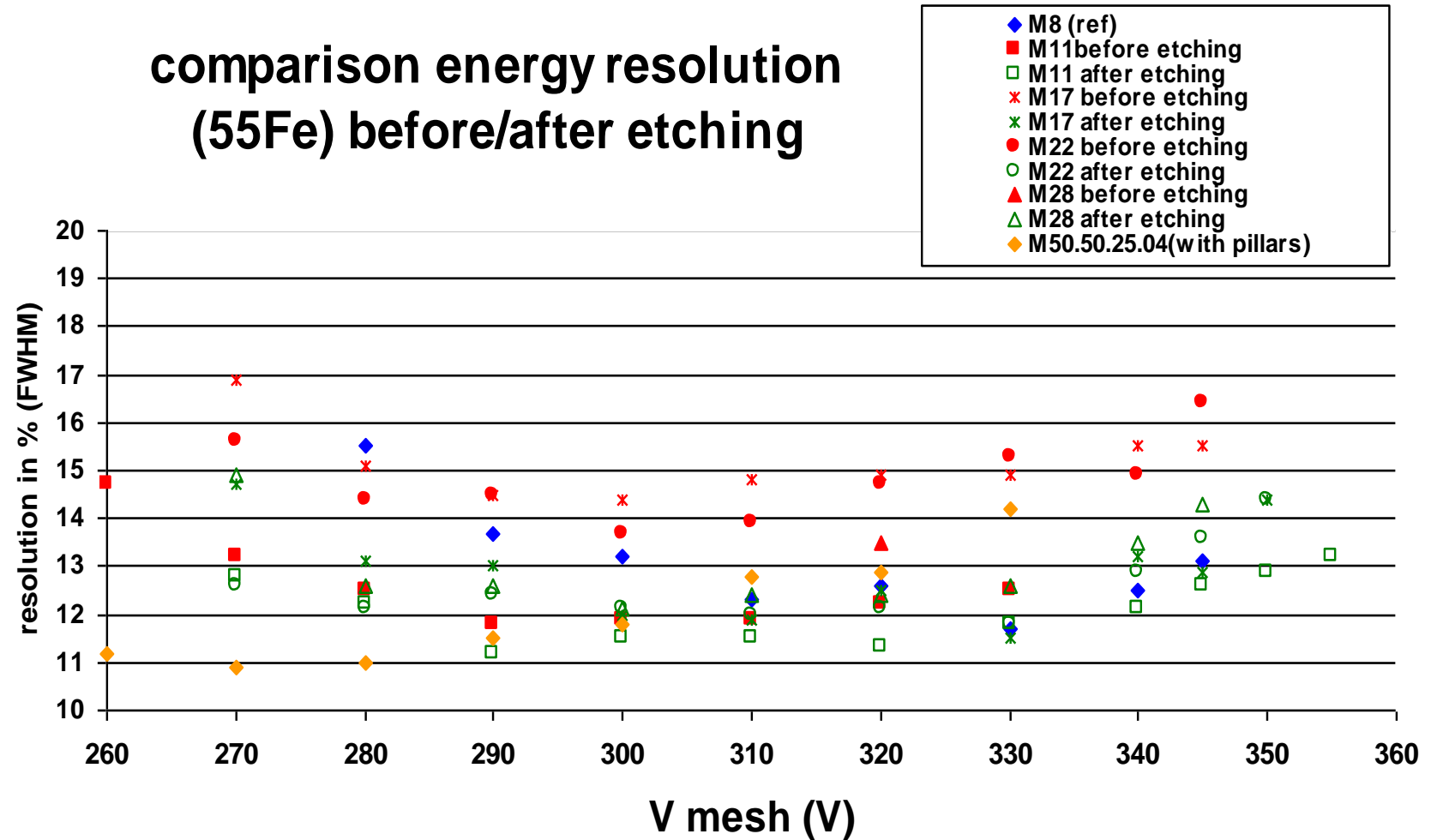


Comparison of gains for the 3 different type of Microbulks



Comparison of the energy resolution for the 3 different type of Microbulks

comparison energy resolution
(^{55}Fe) before/after etching



5) Summary of results

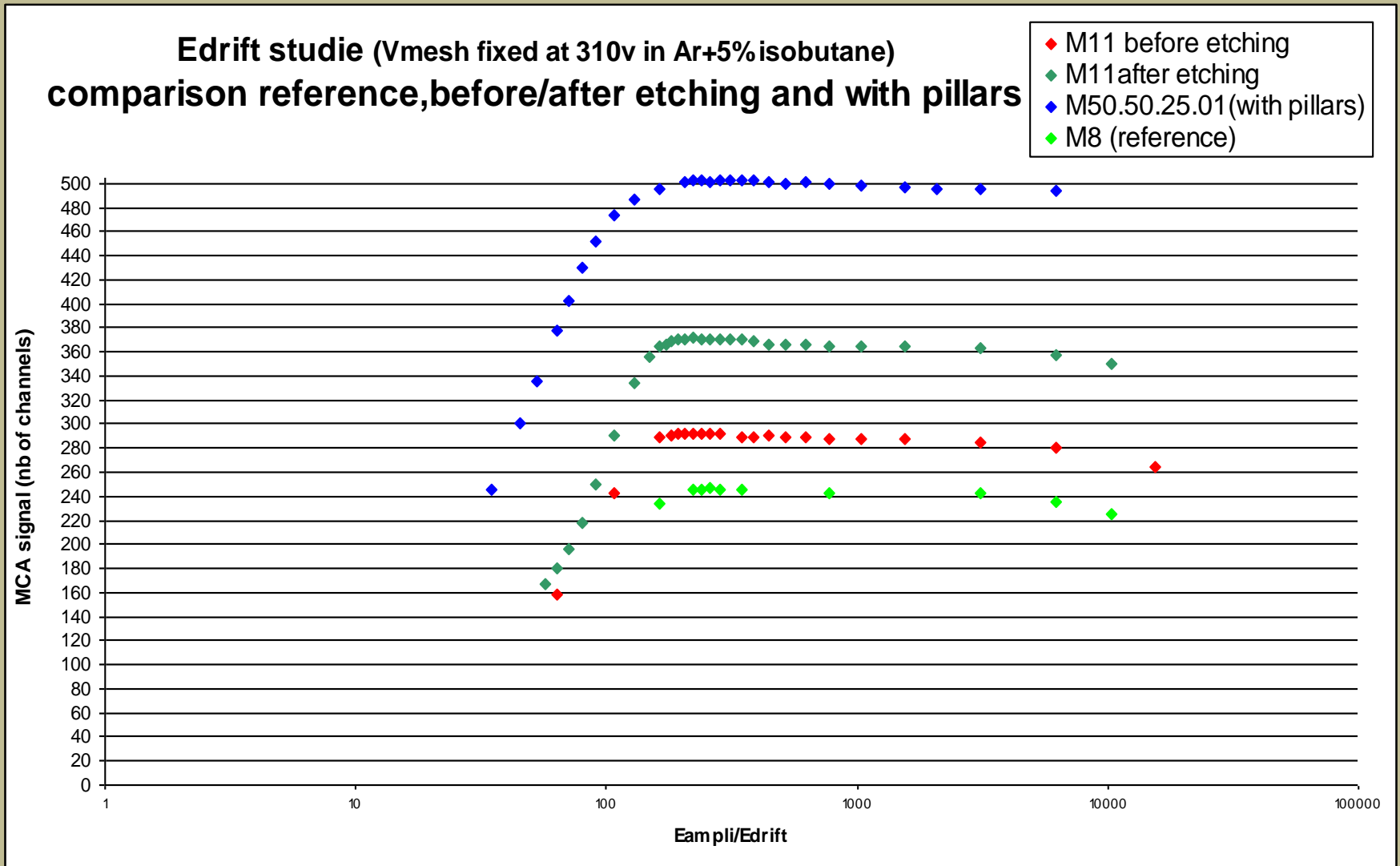
reference number	M8 (reference)	M 11	M17	M22	M 28	M50.50.25.02
capacity before etching	474 pF	431 pF	449 pF	458 pF	427 pF	193 pF
capacity after etching		375 pF	388 pF	327 pF	371 pF	
capacity difference after etching		-53 pF	-57 pF	-123 pF	-51 pF	
etching time		30 s	30 s	60 s	45 s	
voltage in the air		600 V (1 nA)	610 V (2 nA)	640 V (2 nA)	600 V (1 nA)	600 V(0 nA)
gain max in Ar+5%iso (before etching)	18300 @ 360 V	6800 @ 330 V	9400 @ 345 V	16000 @ 360 V	22660 @ 375 V	60000 @355 V
gain max (Ar+5%iso) after etching		19740 @ 355 V	18900 @ 355 V	22540 @ 355 V	21320 @ 355 V	
difference gain after etching		8,5%	32%	43%	41%	
difference energy resolution after etching		8,5%	19%	19,5%	9%	

6) Conclusion

- Microbulk provides excellent resolution
- Additional etching allows:
 1. Decreases the capacity (\Rightarrow decrease of noise)
 2. Improves the gain
 3. Improves energy resolution
- R & D will continue to optimise the parameters of the etching process
- Best performance obtained with pillar Microbulks

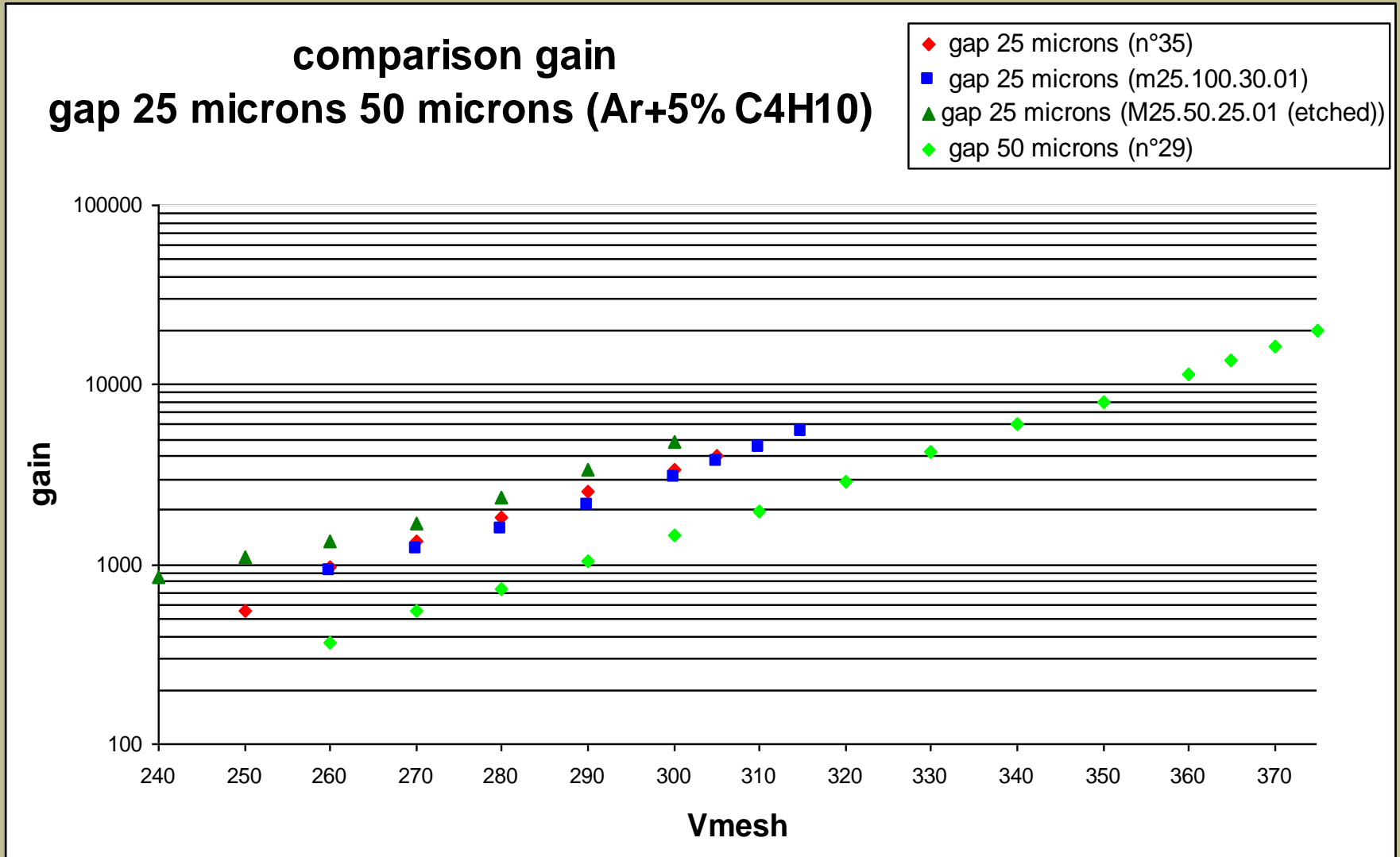
Back up slides

11) Annexe results (electron transmission)



11) Annexe result

Gas test (gap 25 and 50 μm)



12) Etching

