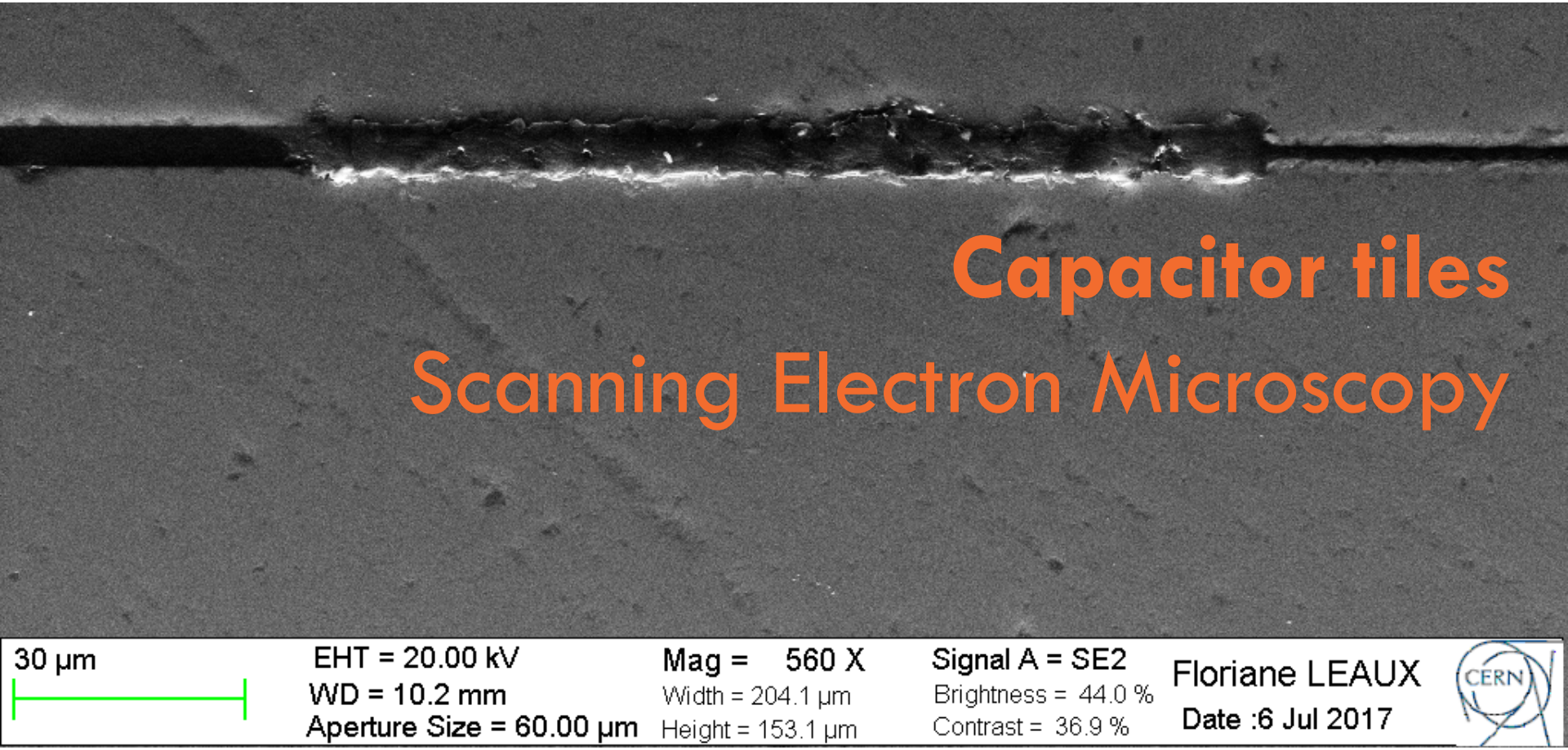
Capacitor tiles

Scanning Electron Microscopy

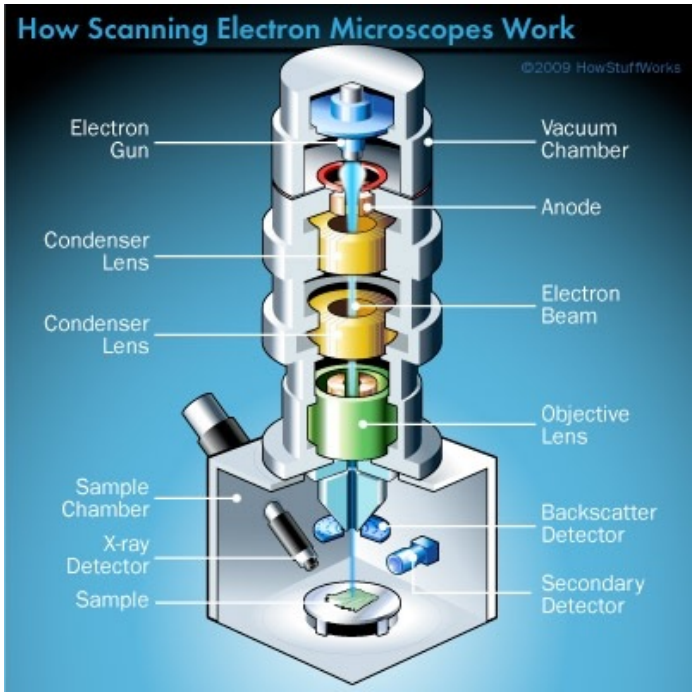


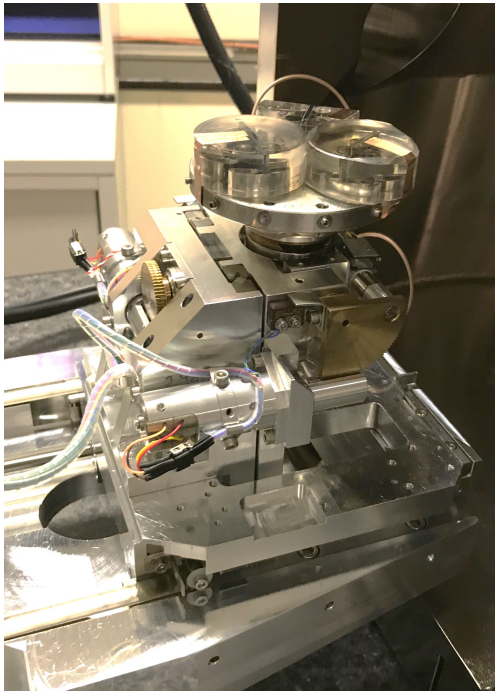
Mateus Vicente

Introduction

Scanning Electron Microscopy

- Works detecting secondary electrons emitted by atoms excited by the electron beam.
  - SEM can achieve resolution better than 1 nanometer.



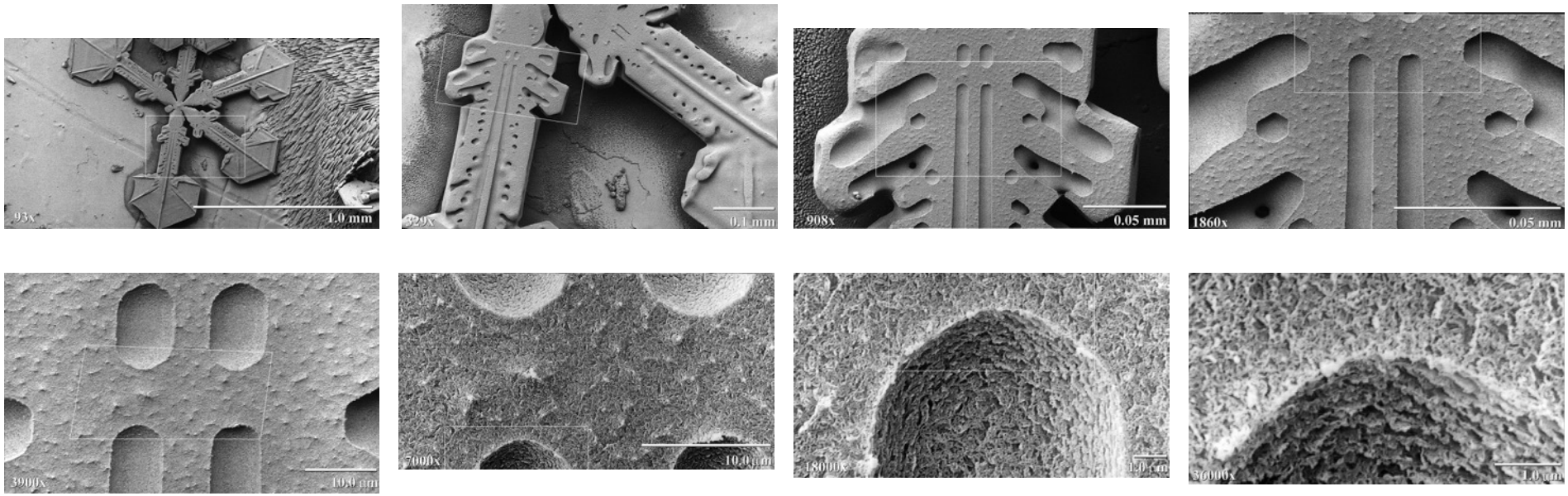


Samples being loaded

Introduction

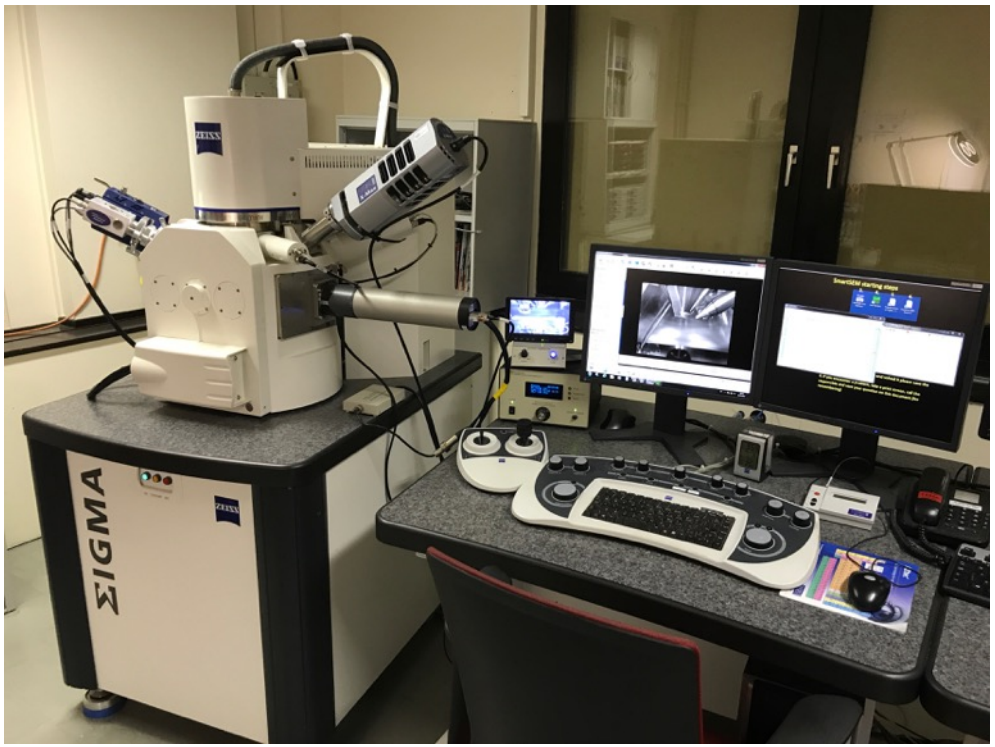
Scanning Electron Microscopy

SEM example pictures of a snow flake *(from wikipedia)*



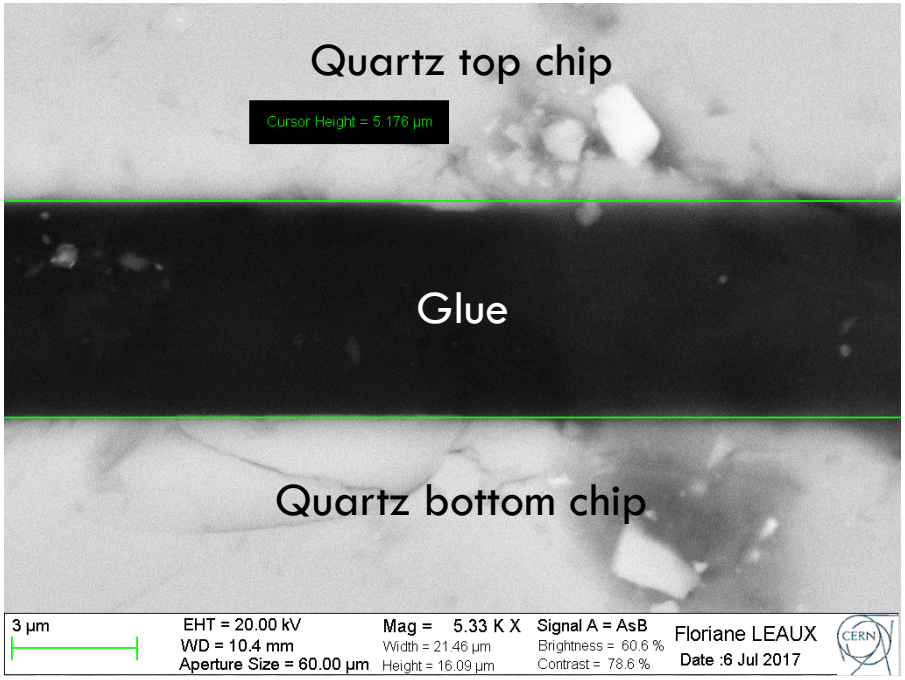
SEM Setup - CERN EN-MME-MM

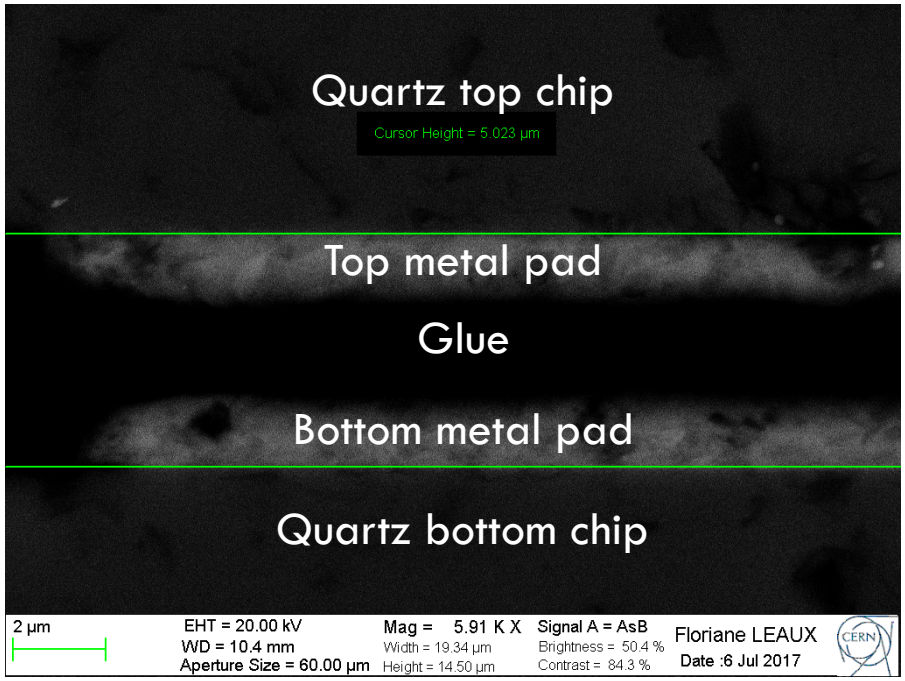
- To avoid charge accumulation and image deformations, conductive carbon coating by PVD is done on the samples



SEM Pictures

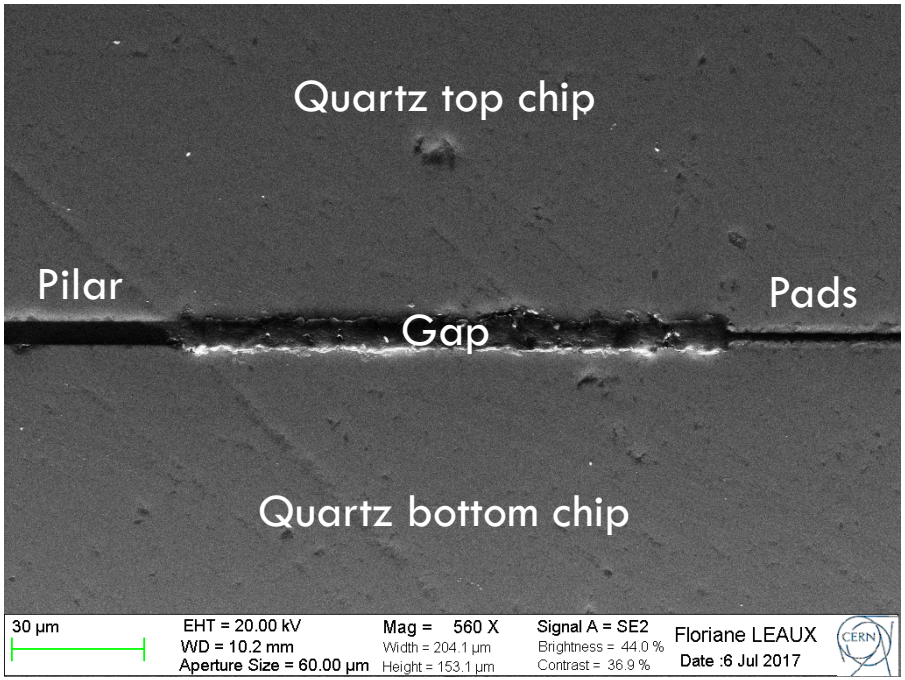
- Capacitor tile cross-section

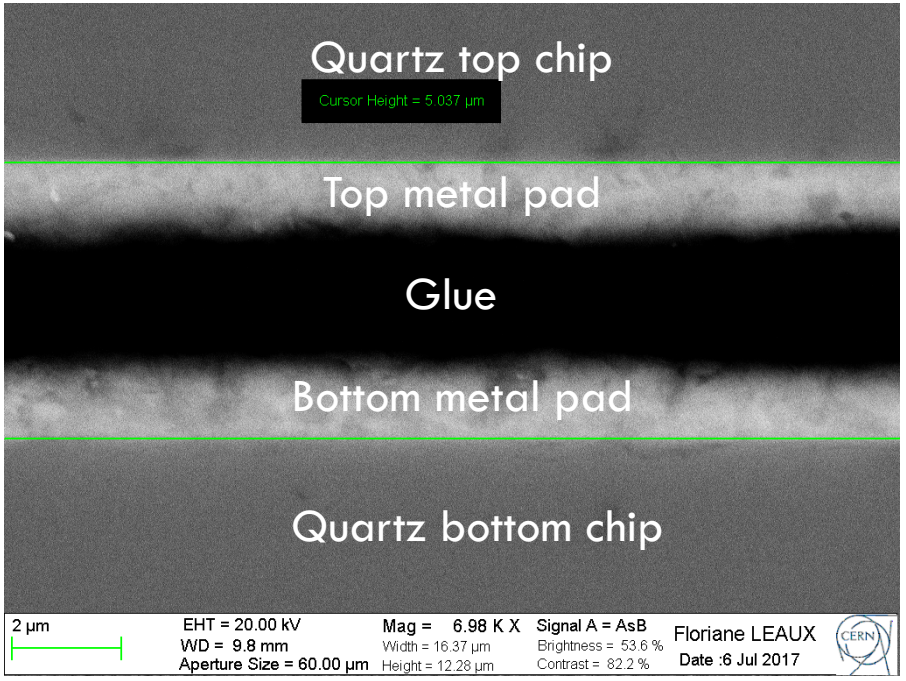




SEM Pictures

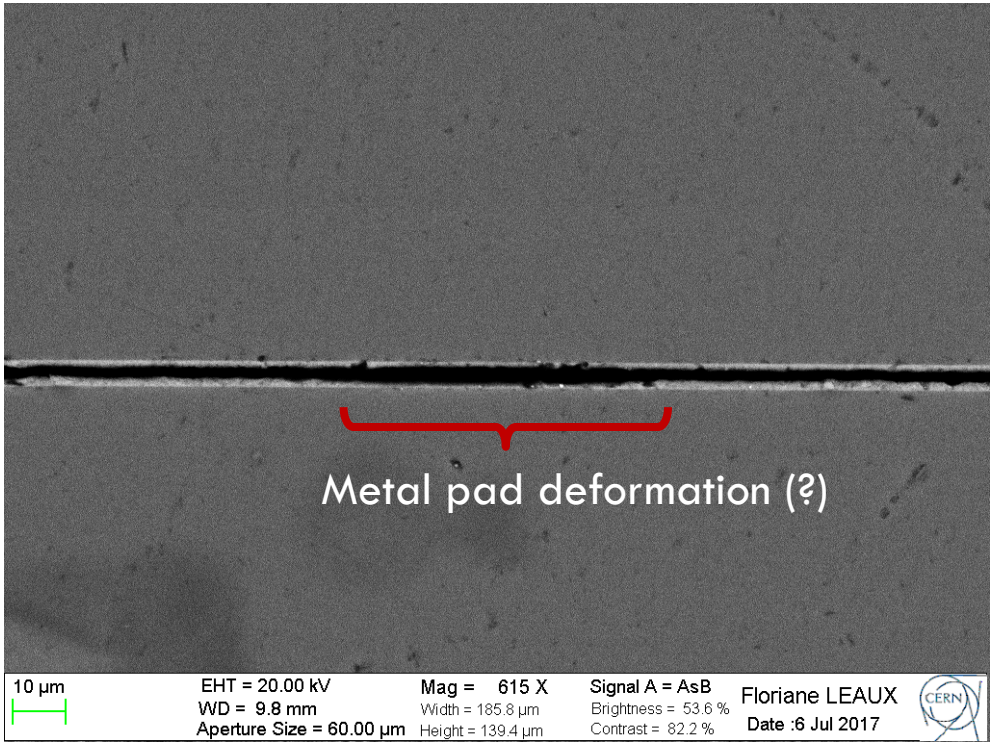
- Capacitor tile cross-section





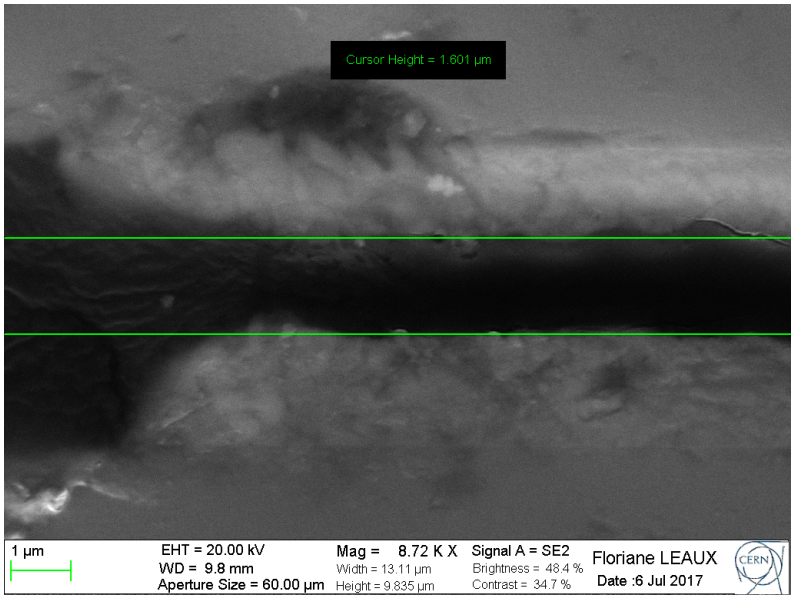
SEM Pictures

- Capacitor tile cross-section
  - Possible metal pad deformation (due to 10kg bonding weight(?)). To be verified.



SEM Pictures

- Glue thickness
  - Not trivial to measure due to bad cross-section polishing
- Compare with measured capacitance and review our capacitance-gap simulation/calibration
  - Investigate if (possible) air bubbles trapped between the pads have big effect on final capacitance



	Capacitance				Capacitance			
3	4,15	4,03	4,06	3,97	3,87	3,96	3,87	4,13
2	3,52	3,4	3,6	3,39	3,18	3,32	3,58	3,77
1	5,67	3,31	3,48	3,17	3	3,01	3,6	3,86
1	7,87	3,22	3,14	3,01	3,12	3,28	3,61	4,01
2	3,91	3,58	3,38	3,29	3,39	3,76	3,75	3,77
3	4,08	4,18	4,06	3,98	4,1	4,02	3,73	6,45
	123	456	789	123	123	456	789	123

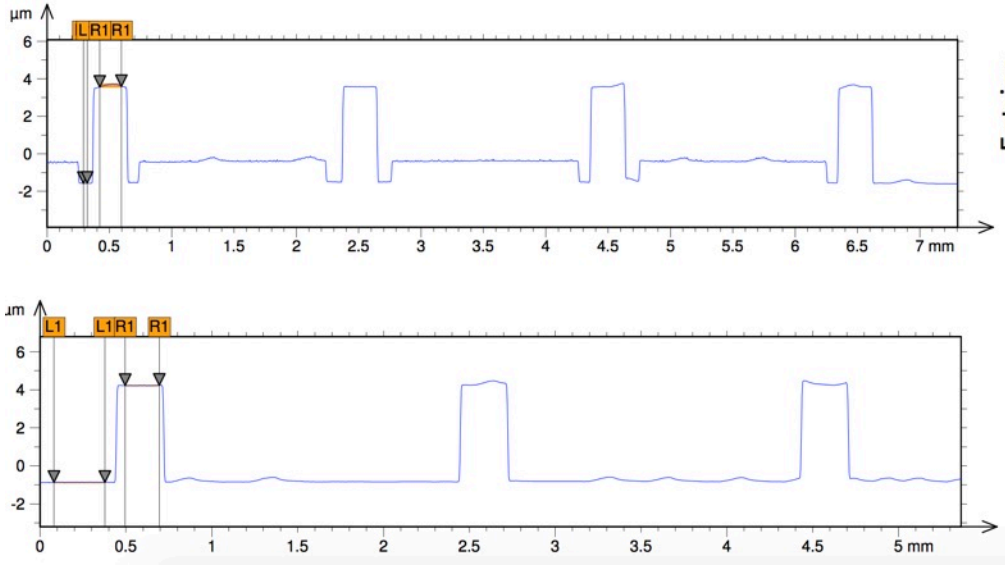
Capacitance

	Height				Height			
3	3,62	3,73	3,70	3,79	3,88	3,79	3,88	3,64
2	4,27	4,42	4,17	4,43	4,73	4,53	4,20	3,99
1	2,65	4,54	4,32	4,74	5,01	4,99	4,17	3,89
1	1,91	4,67	4,79	4,99	4,82	4,58	4,16	3,75
2	3,84	4,20	4,45	4,57	4,43	4,00	4,01	3,99
3	3,68	3,60	3,70	3,78	3,67	3,74	4,03	2,33
	123	456	789	123	123	456	789	123

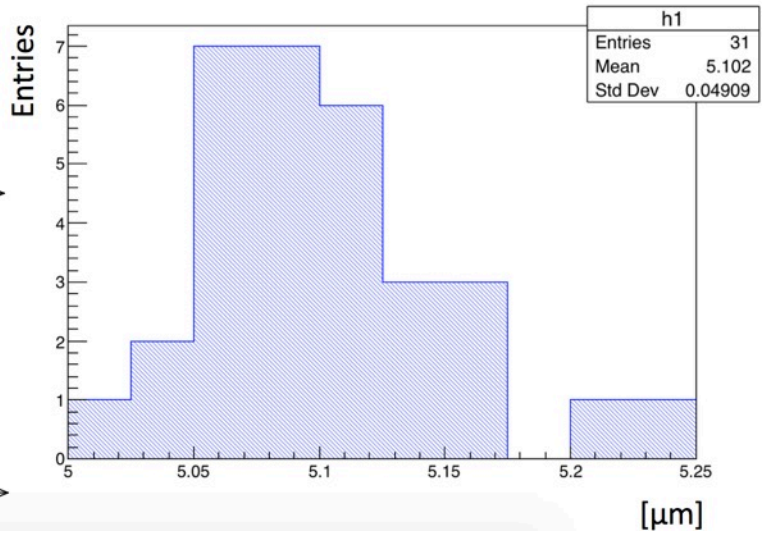
Calculated gap

Pads gap distribution – before assembly

- Height of the pillars measured with a mechanical profilometer (Genova)
  - Average height of **5.1 um**



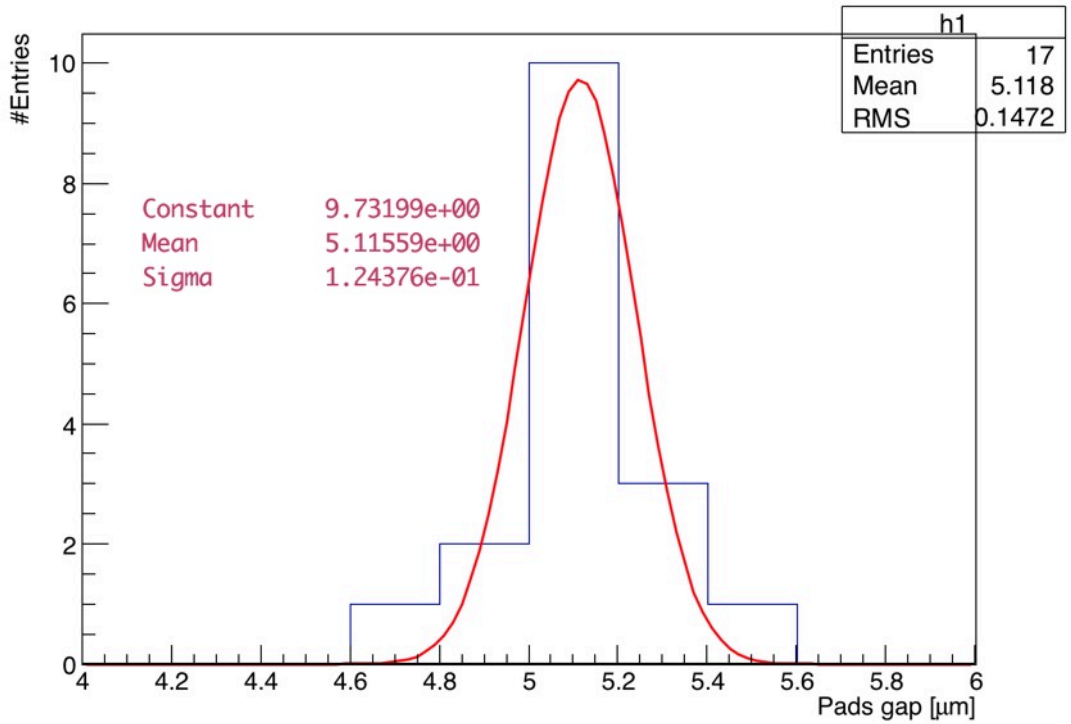
Profilometer measurement



Measured height distribution

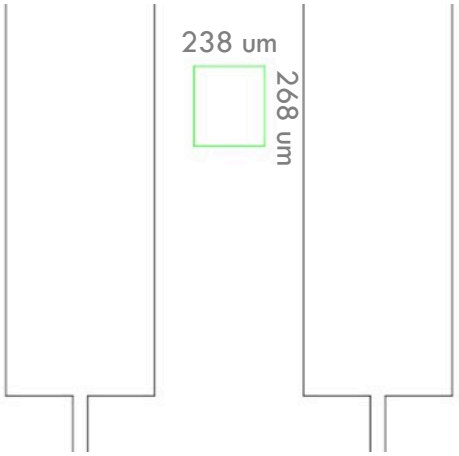
Pads gap distribution – after assembly

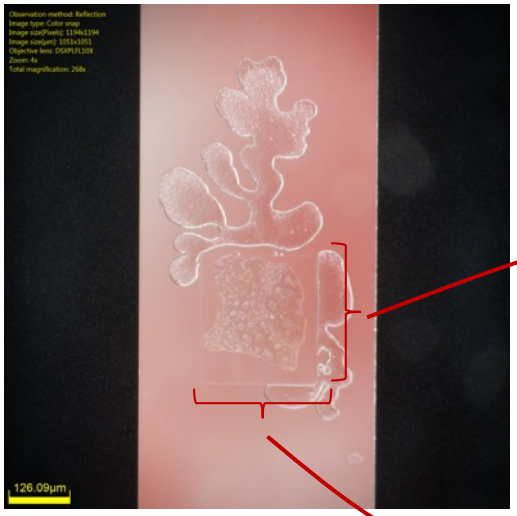
- Gap measurements over ~2cm cross-section (done with SEM at CERN)
  - Average gap of **5.11 um**
  - Very good agreement with measurements before assembly

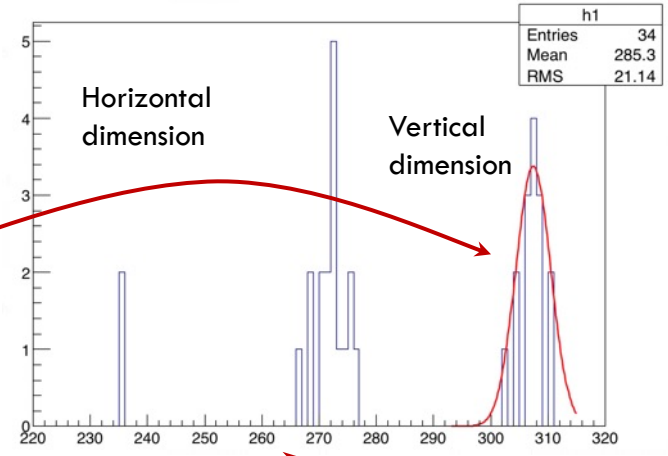


Pillar size

- Pillars of 238x268 um
  - Measurement with a optical microscope
    - ~270x310 um
      - 40 um offset, probably due to light refraction through the quartz glass (to be calculated)
  - With latest SEM pictures, hypothesis of pillars compression discharged







Conclusions and Next steps

- First SEM measurements performed on the capacitor tiles
  - New measurements next 24/07 of next capacitor row (2nd of 6)
    - Cross-verification on assembly parallelism
- Good* agreement of pillars height and tiles gap
  - Pillars can sustain up to 10 kg without being compressed
- New assemblies to be done with different pillar heights
- Next step: Pillars implementation on FEI4 assemblies with H35DEMO (to be confirmed)

*If not perfect =)