

Aluminum GEM

RD51 mini week 15/12/17

R&D IPPLM (Warsaw)/CERN

- Aluminum knowledge at CERN MPT workshop
- GEM process
- Malter effect
- Low mass Read-out possibilities with Al strips

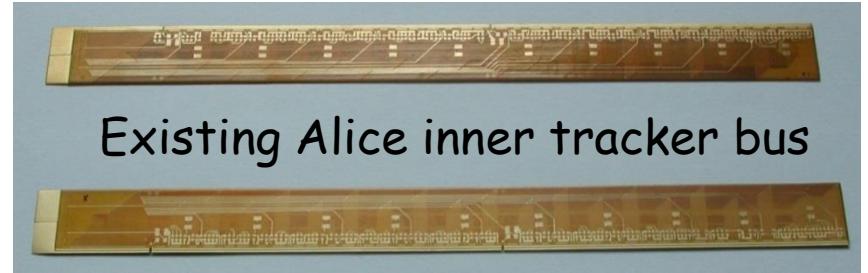
Material budget

Material	Radiation length [cm]	Density [gr/cc]	Resistivity [uohms*cm]
Gold	0.3	19.3	2.4
Copper	1.4	9.0	1.7
Aluminum	8.9	2.7	2.7
Glass epoxy	19.4		
Polyimide	29.0		
Beryllium	35.3	1.9	3.3

Copper is close to 6.5 times less transparent than aluminum
And aluminum has only 1.6 times the resistivity of copper
Polyimide is 1.5 times better than glass epoxy.



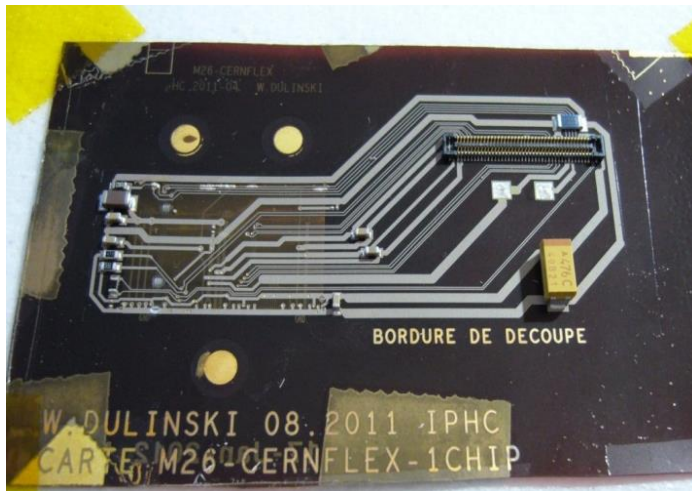
Alice inner tracker upgrade bus



Existing Alice inner tracker bus



Aluminium Heater



Silicon detector embedded in flex

15/12/2017

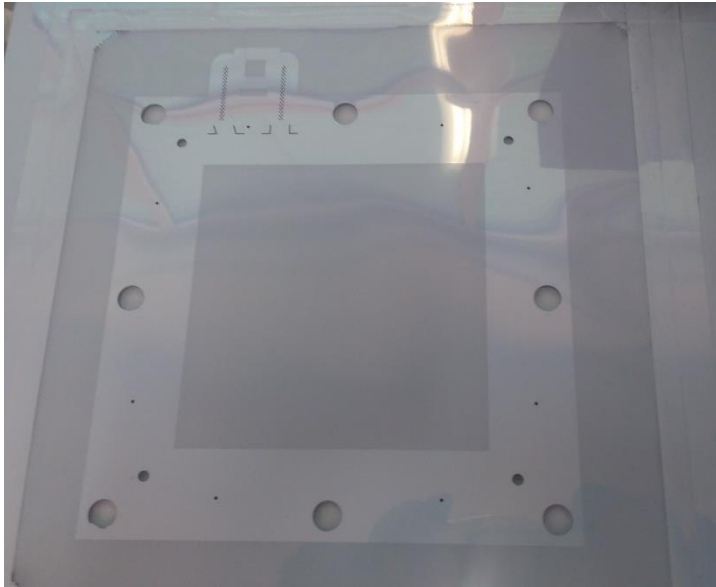


ATLAS IBL bus

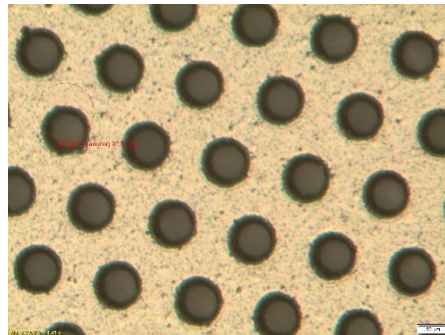
Aluminum capabilities at CERN-MPT

- Glued aluminum foils : 7um to 200um
- Vacuum deposited AL up to 30um
- Microvia plating
- Ni/Au plating
- Multilayer structures

- Aluminium GEM Before processing

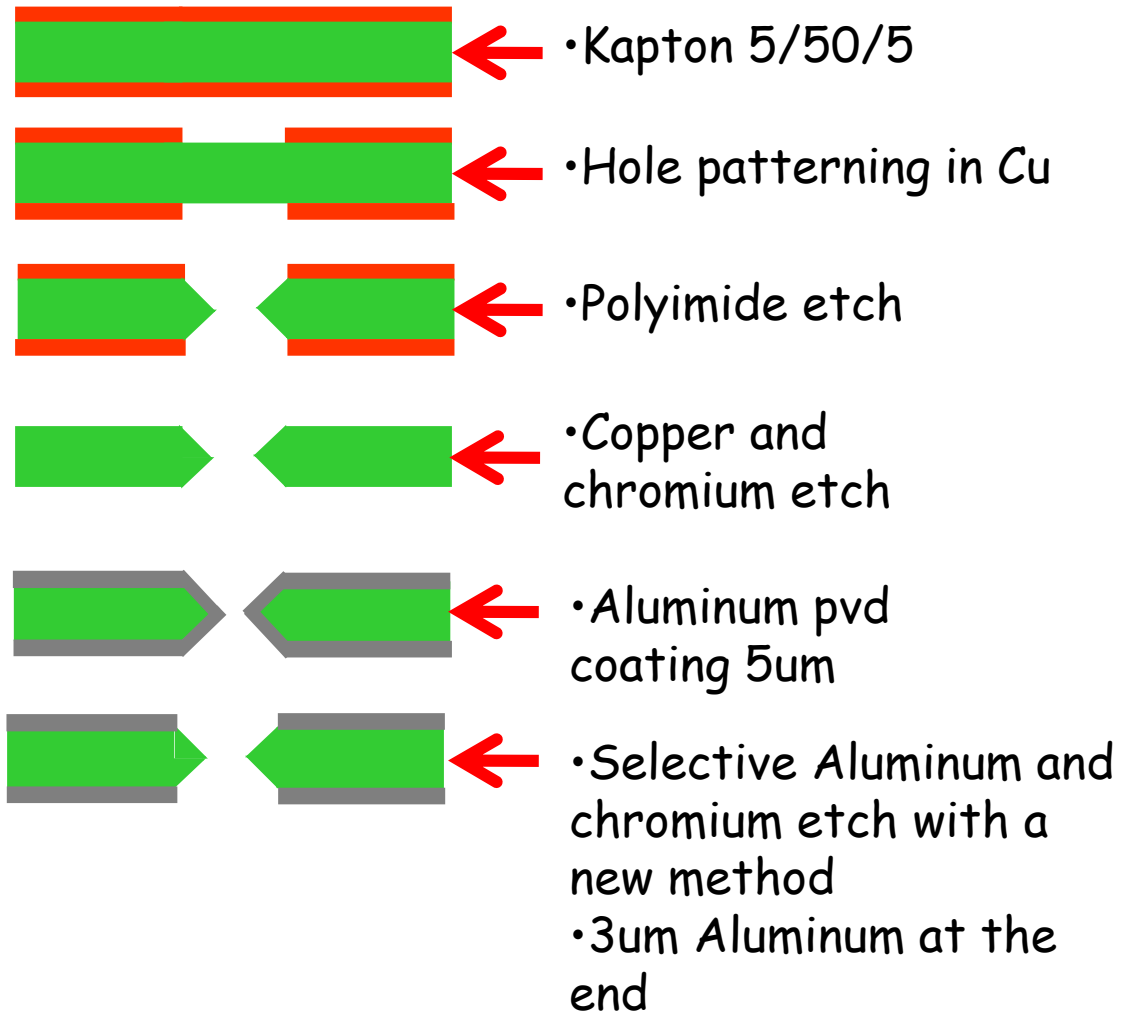


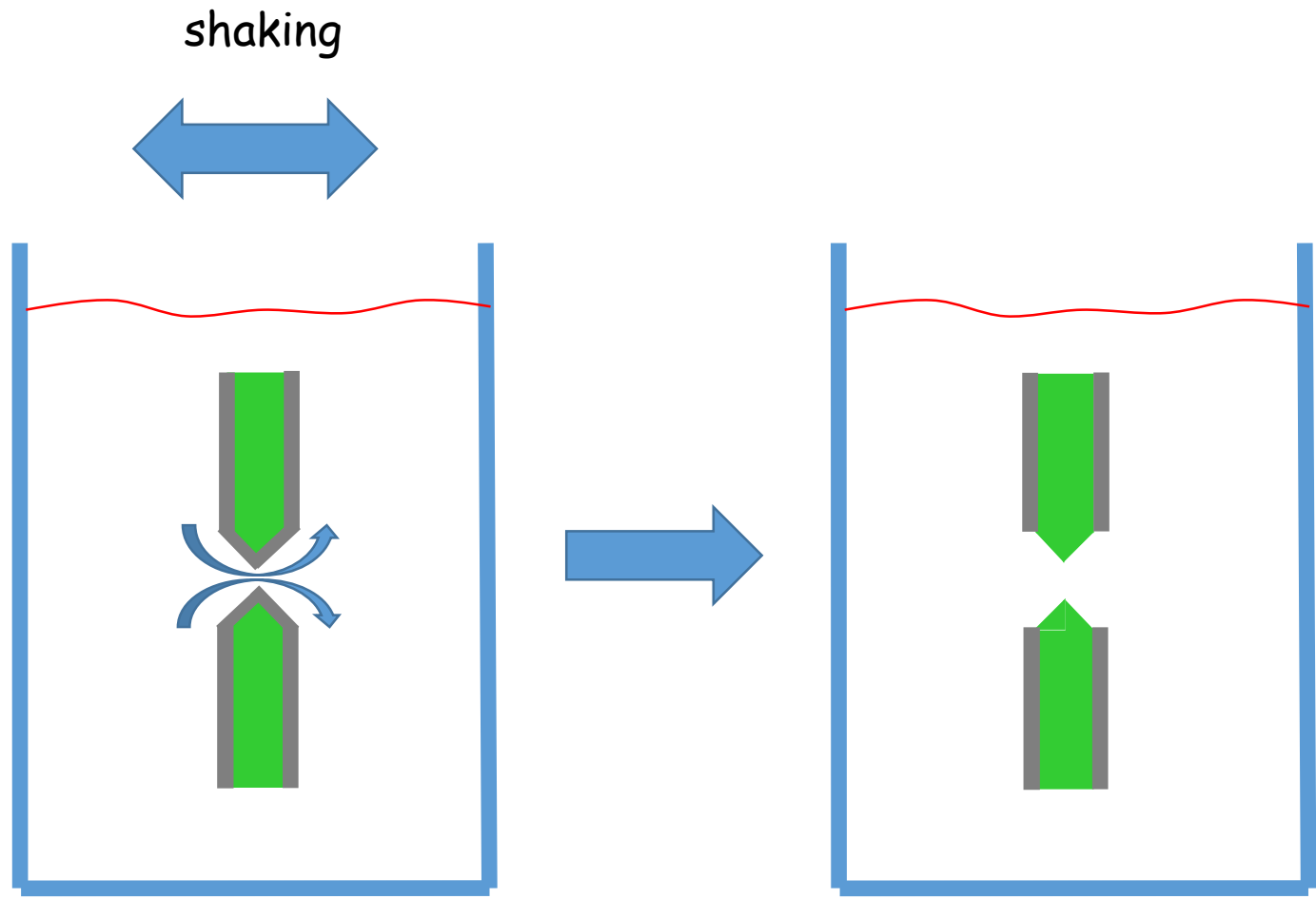
- Finished Aluminium GEM



- STD pattern 140um /70um
- Less than 10nA at 600 V

•Process flow





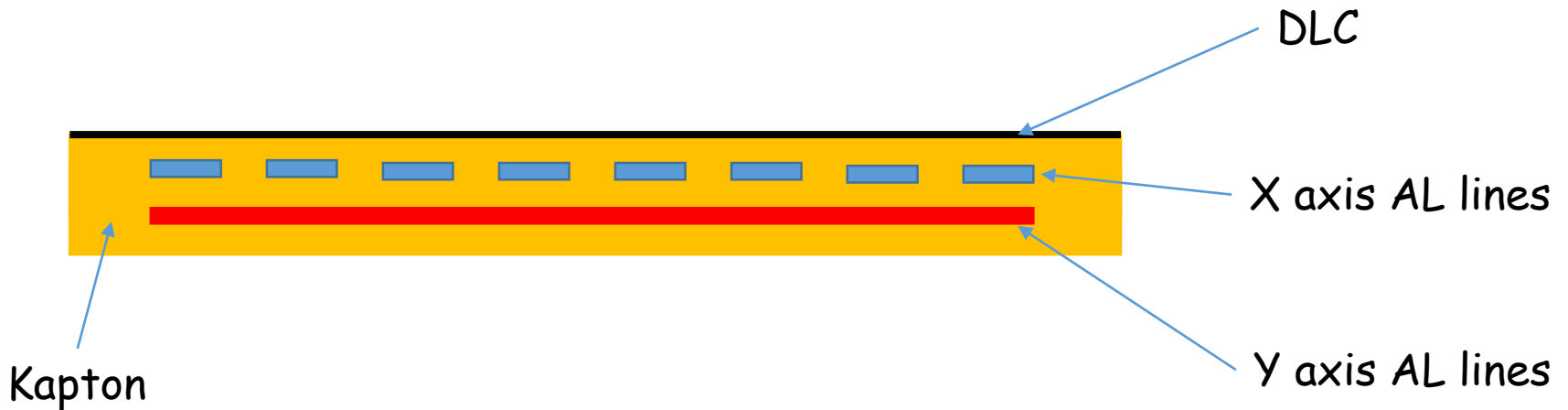
Low etching rate bath
Etching rate much bigger in the holes
Typ : 25 min
Initial Al Thickness 5 um

Final Al Thickness 3um

Malter effects

- We are thinking to use Alodine treatment to stabilize the oxides and keep surface electrical conductivity. (Chromic acid treatment)
- This treatment is available with Cr VI and Cr III
- Thicknesses from a few atomic layers up to 3um
- Other treatments like Eloxage or Anodization will only create a strong oxide protection increasing Malter effect
- Treatment not yet tested

Low mass read-out



- Full Al structure
- 5um minimum Al thickness
- Ni/Au treatment of connectors for STD assembly
- No Kapton etching
- Rate and Cluster size related to DLC resistivity
- Spark protected