

Development of MicroMEGAS using sputtered resistive electrodes for ATLAS upgrade

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Requirements for ATLAS NSW MM

High position resolution for one dimension

- <100 μm for eta direction.
(Resolution of a few cm is allowed for second coordinate.)

Tolerant for high rate HIP particles

- $\sim 5\text{kHz}/\text{cm}^2$

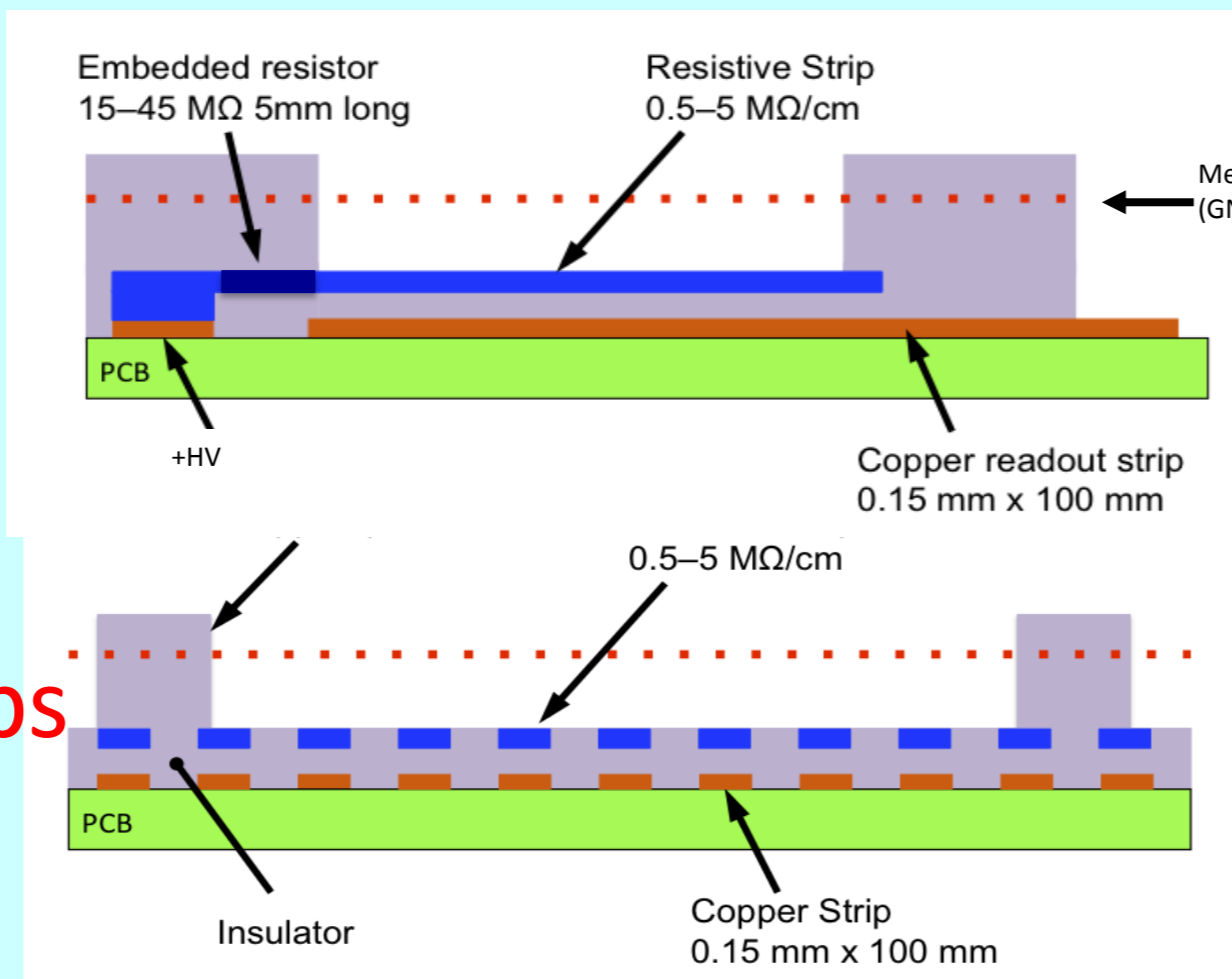
Resistive layer should be formed as strips

There should be a technology for large size production ($\sim 1\text{m}$)

Mass production should be available

- A few thousand board should be produced in 1~2 years.

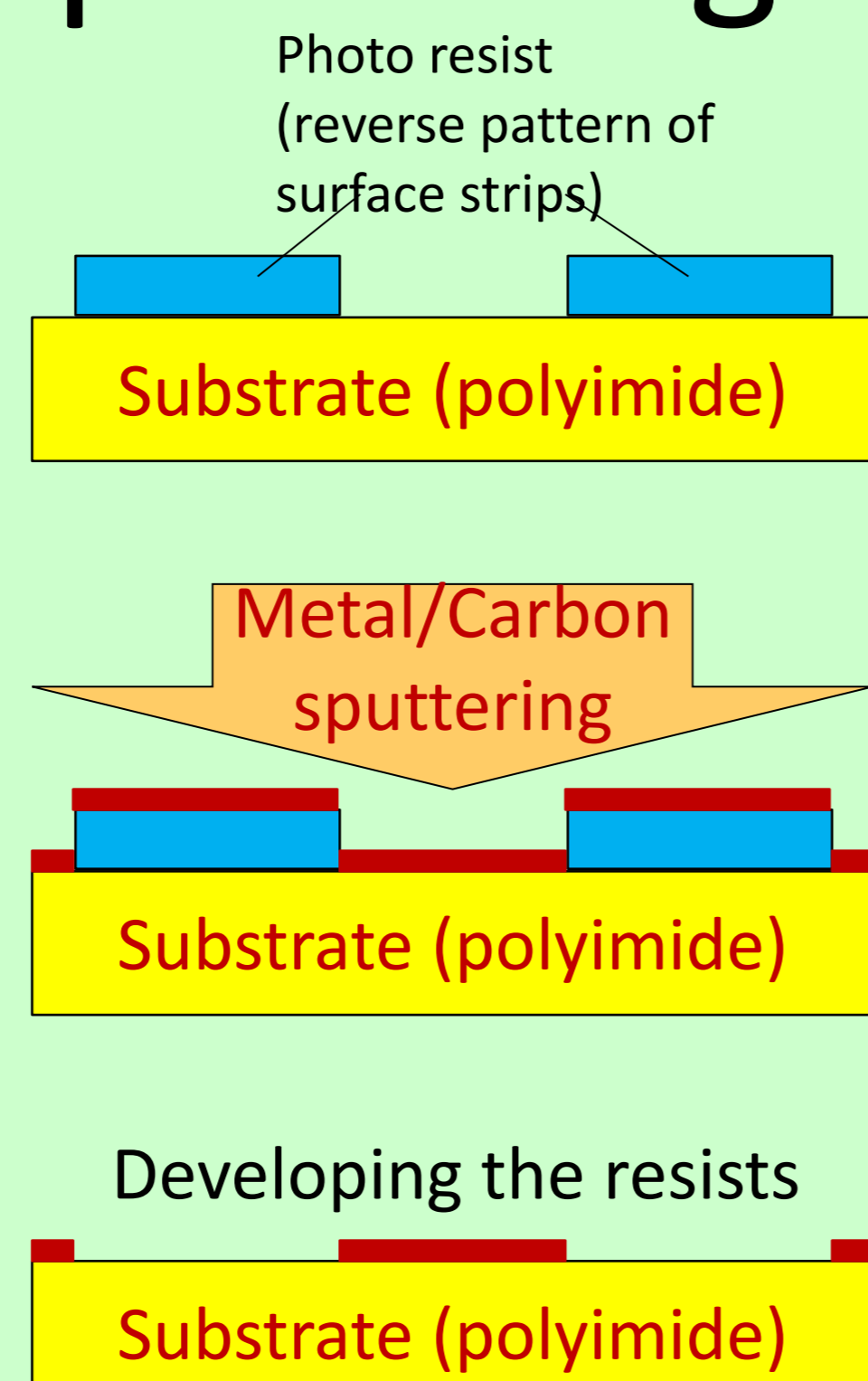
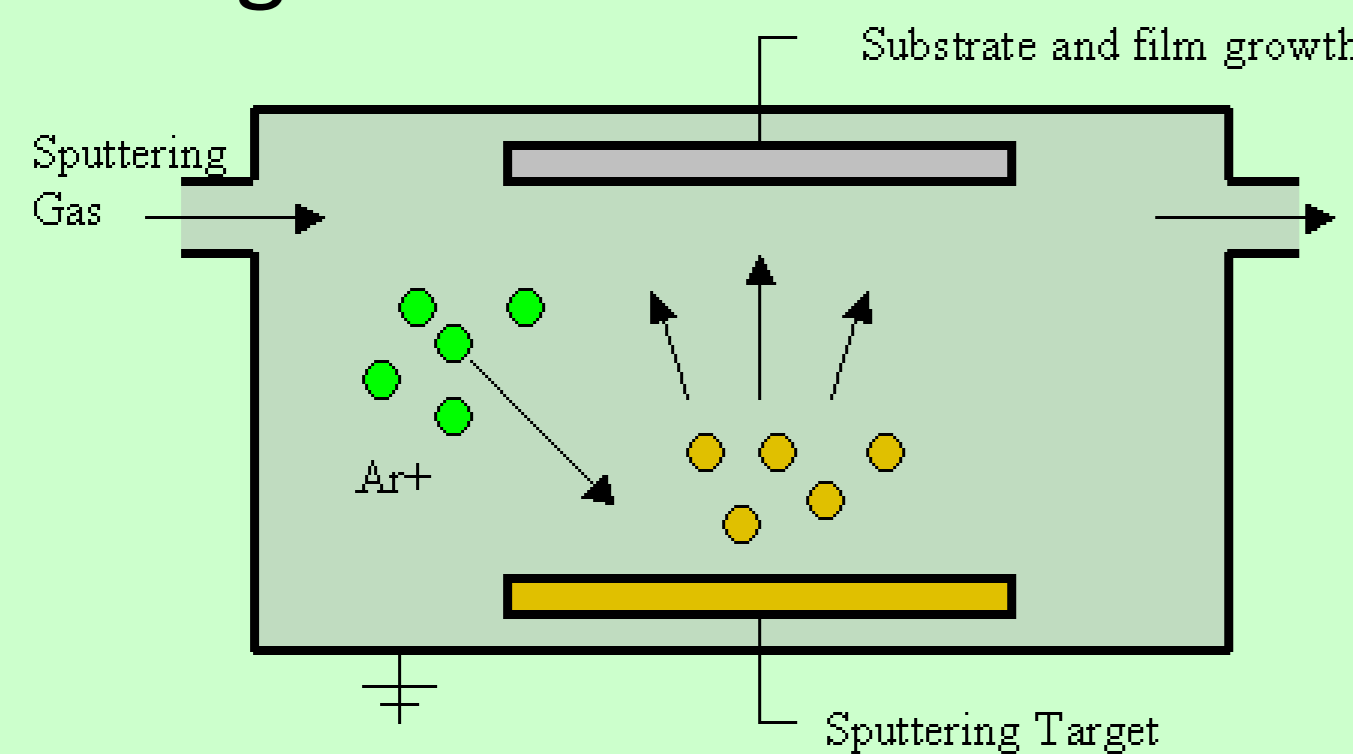
Low cost is preferable



Liftoff process using sputtering

Very fine structure (a few tens micro meter) can be formed using photo resist. (same as PCB)

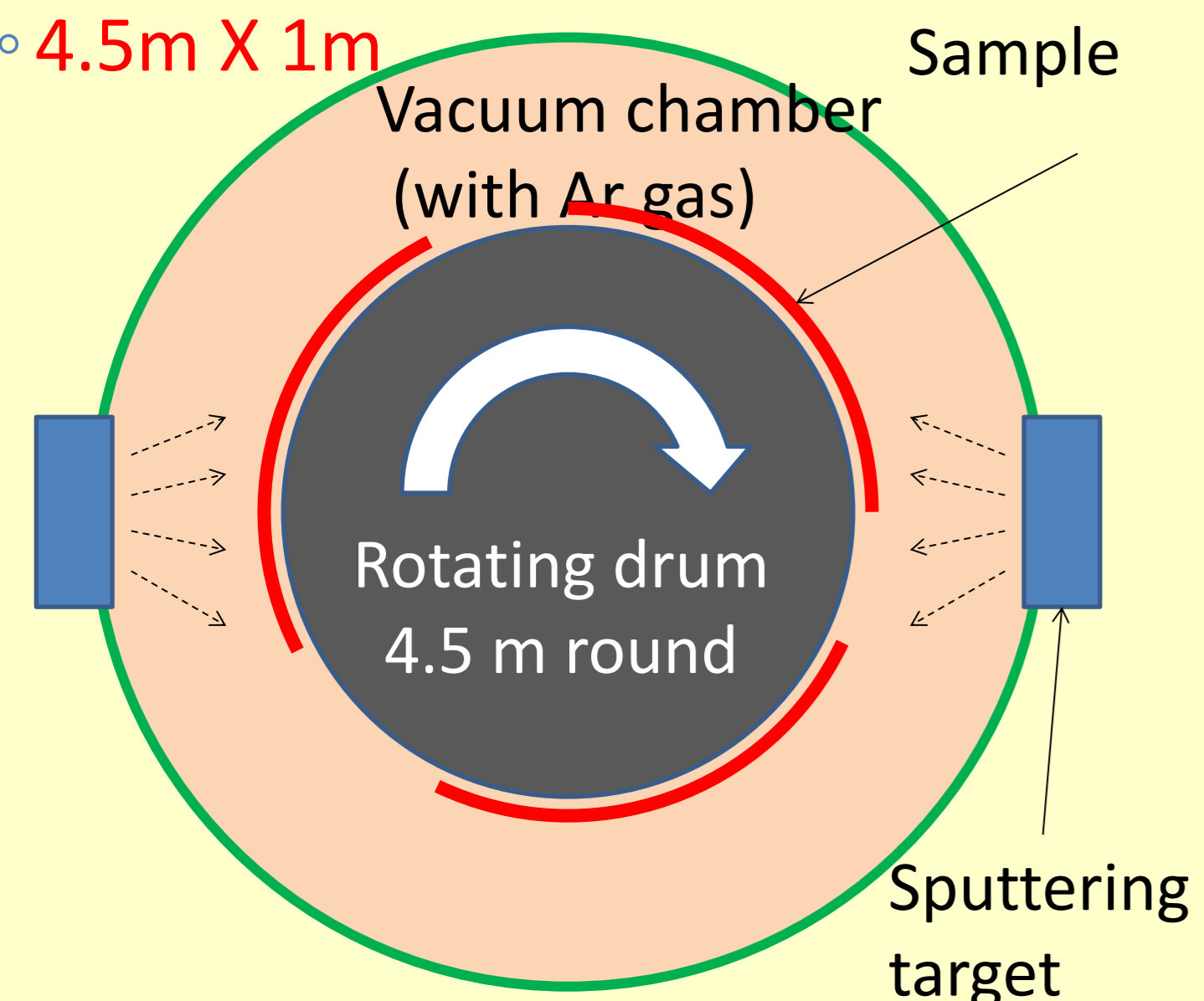
Surface resistivity can be controlled by sputtering material and their thickness



Sputtering facilities

Large size sputtering is available.

- 4.5m X 1m



Prototype of resistive strips

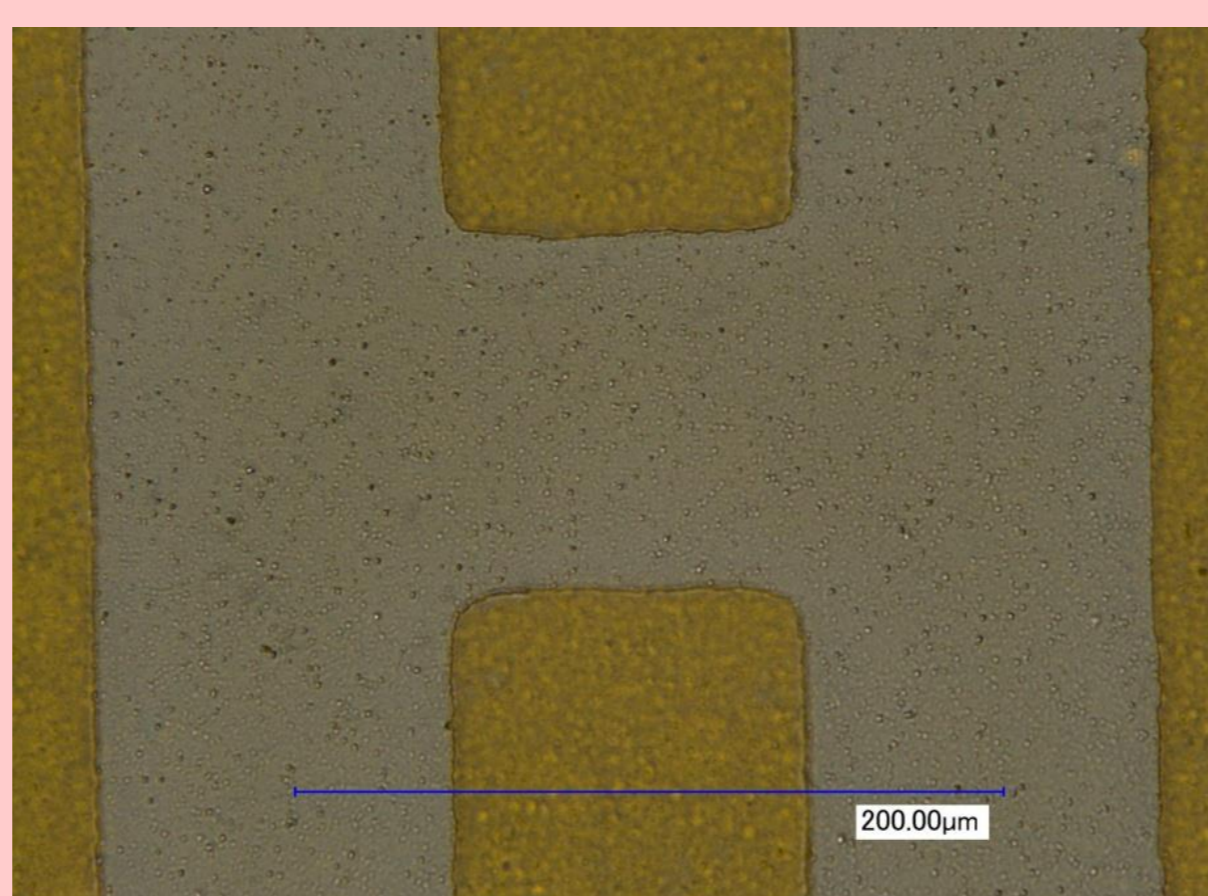
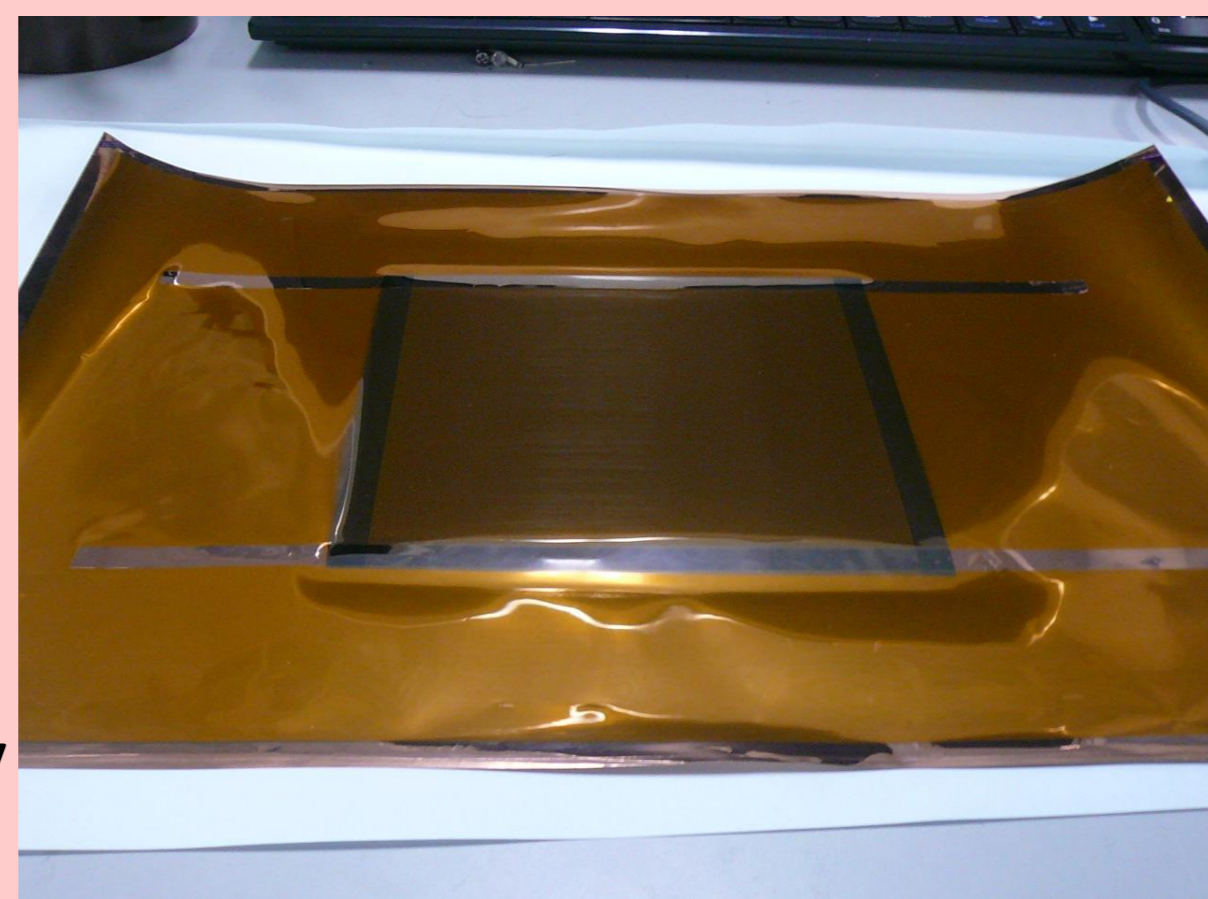
Fine strip pitch of 200 μm is formed on 25 μm polyimide foil.

- More fine structure will be available.

Surface resistivity is 2M – 10M

- Depend on carbon thickness

It keeps strong adhesion and stability



Carbon (300-600 \AA)
Tungsten (10-50 \AA)
Substrate (polyimide)

First operation test for sputtering MicroMEGAS

Two prototype chambers with 10cm x 10cm have been just delivered on June 2013.

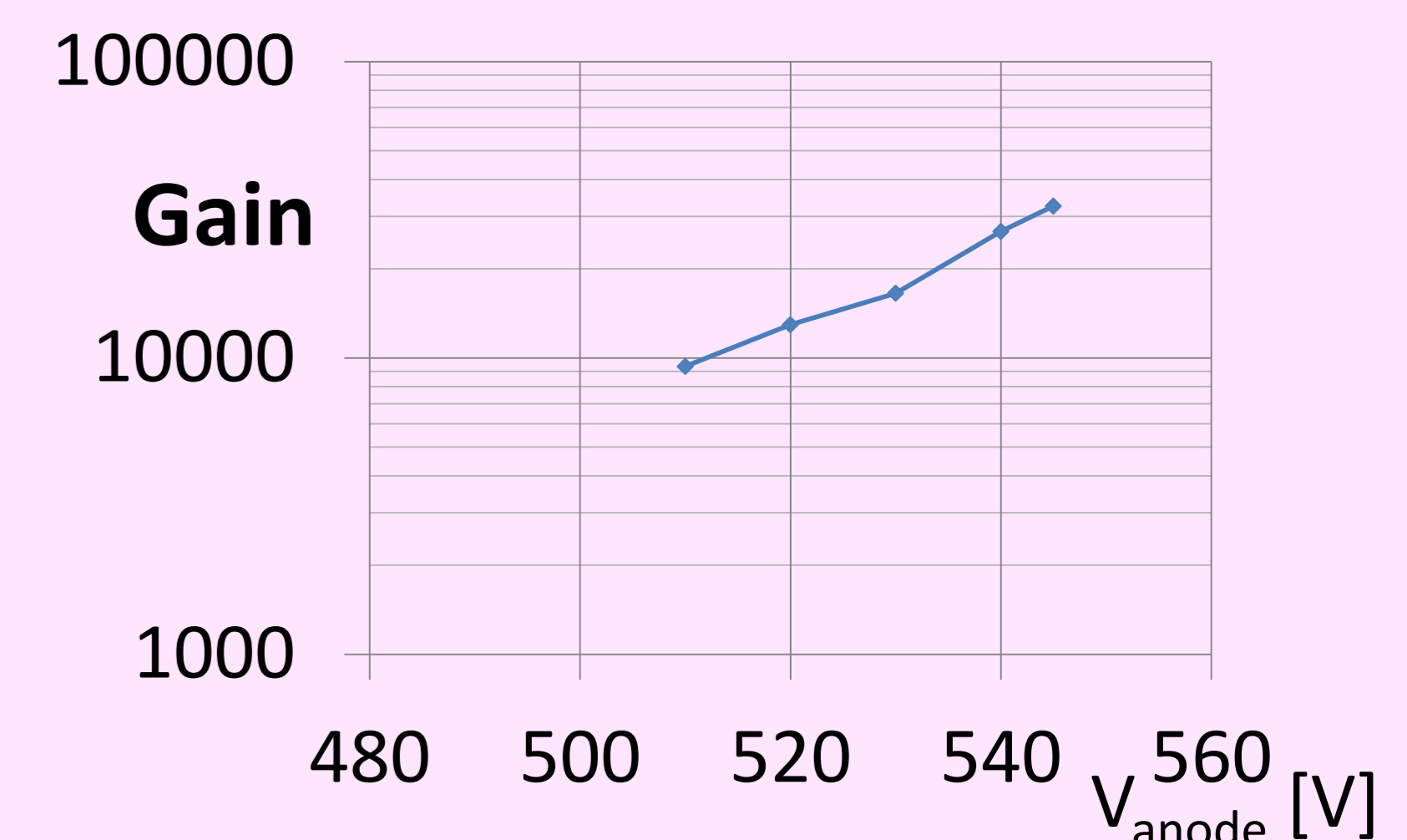
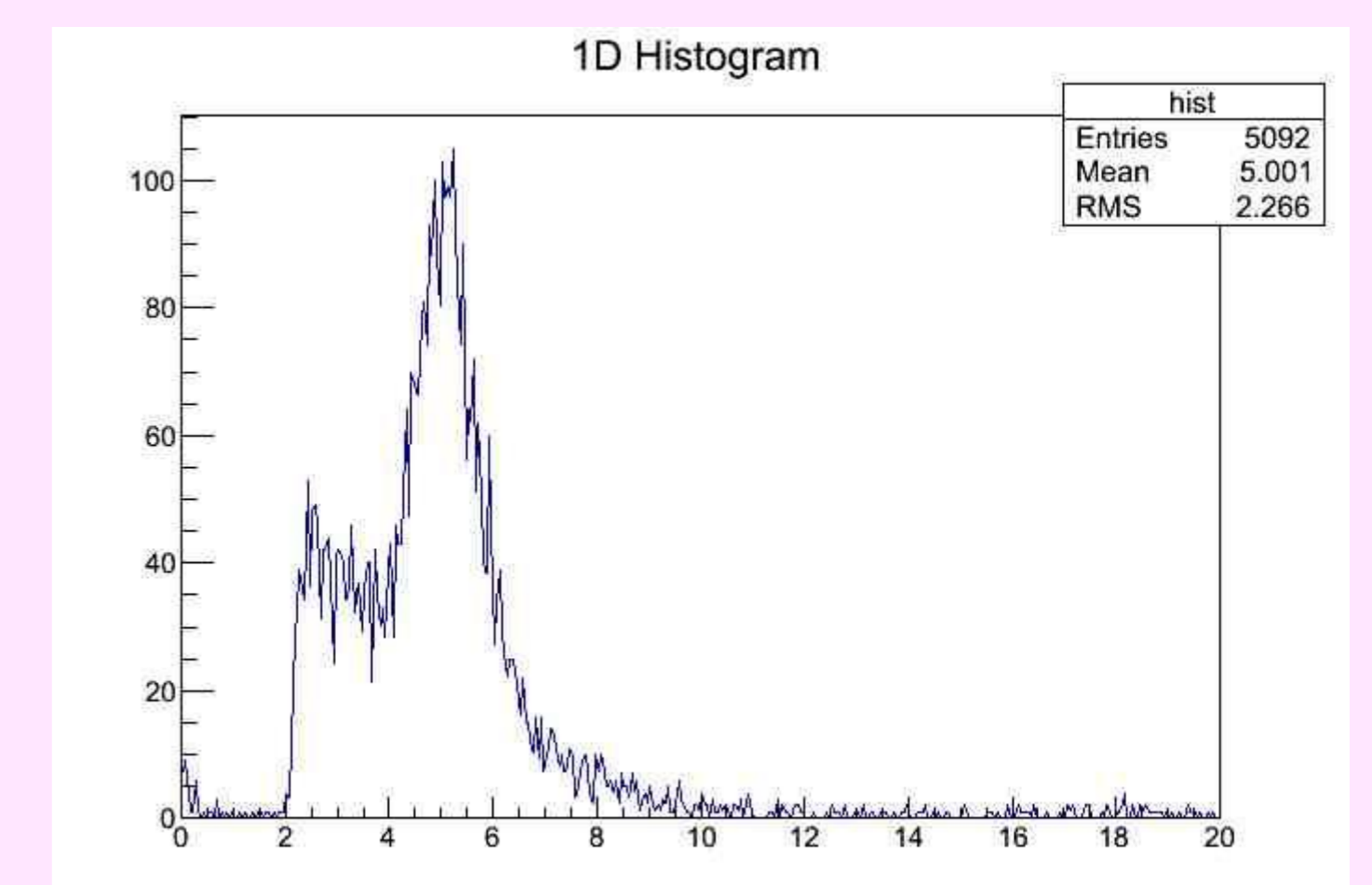
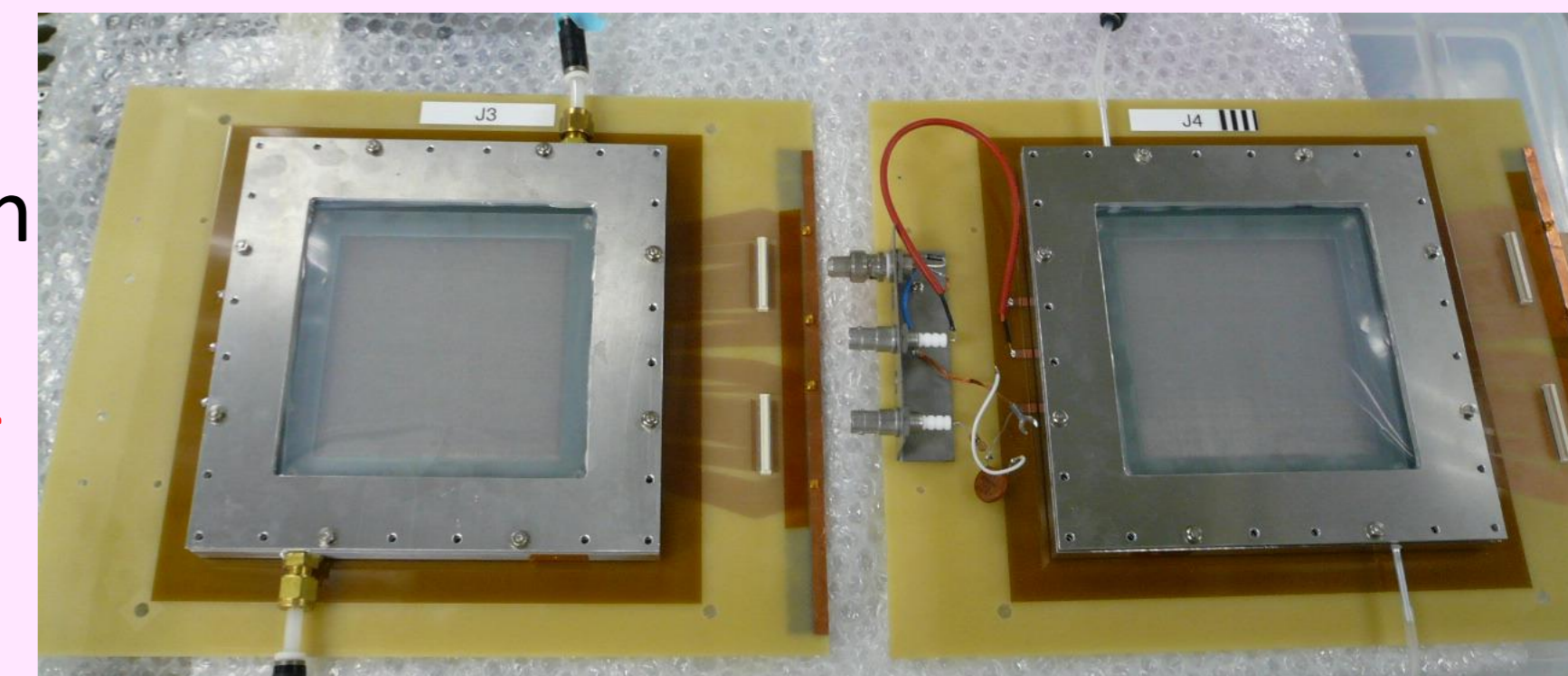
These are first prototypes of MPGD using sputtering technique for resistive electrodes.

Pulse height distribution of 5.9 keV X-ray.

- Anode = 540V, Drift = -300V
- Drift spacing: 5mm
- Gas: Ar(93%) + CO₂(7%)
- Estimated gain ~ 20000

Gain curve

- Using Ar(93%) + CO₂ (7%) gas
- Drift gap is 5mm
- Drift voltage is -300V
- This is very preliminary data



Neutron test for spark studies

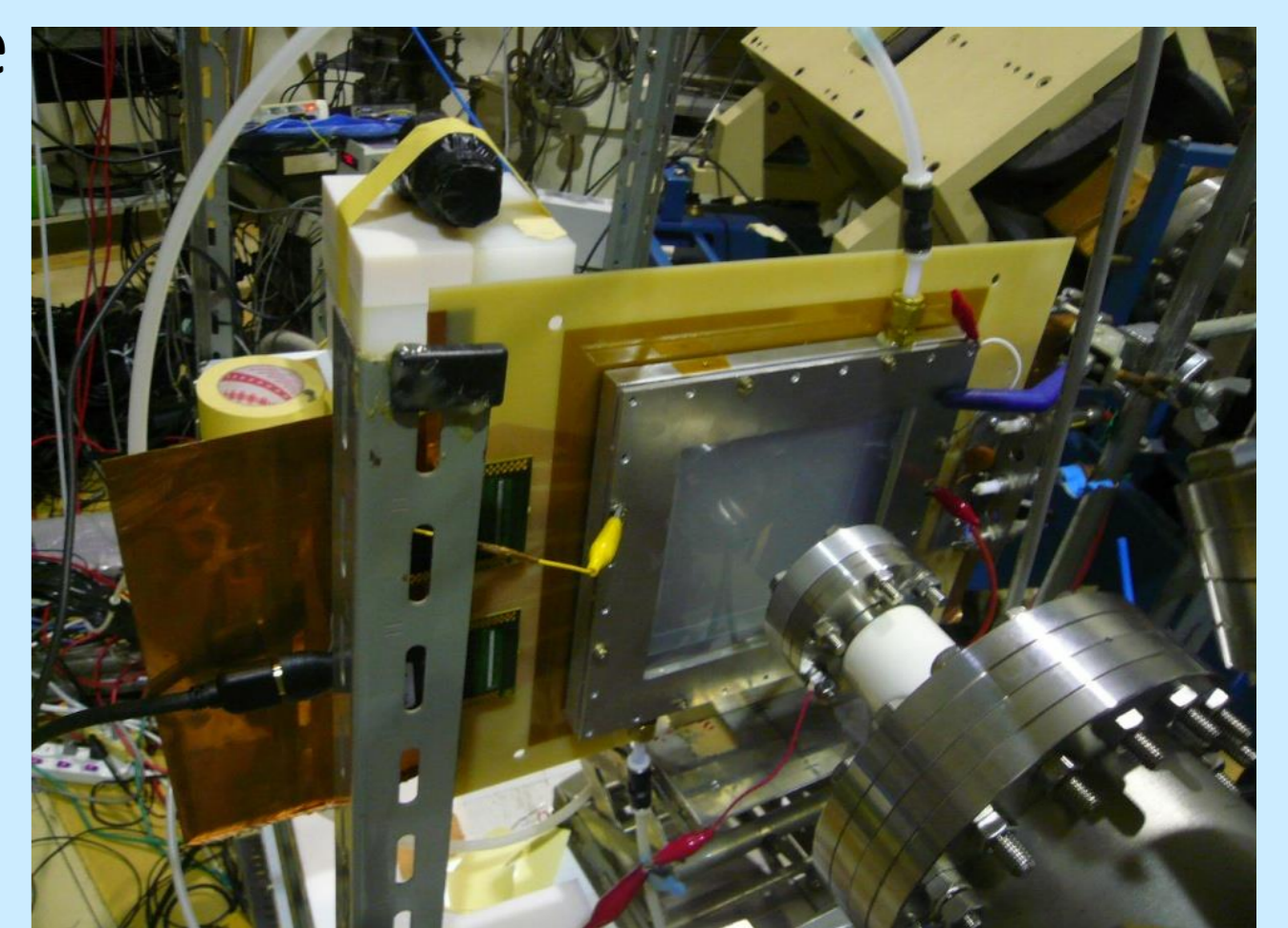
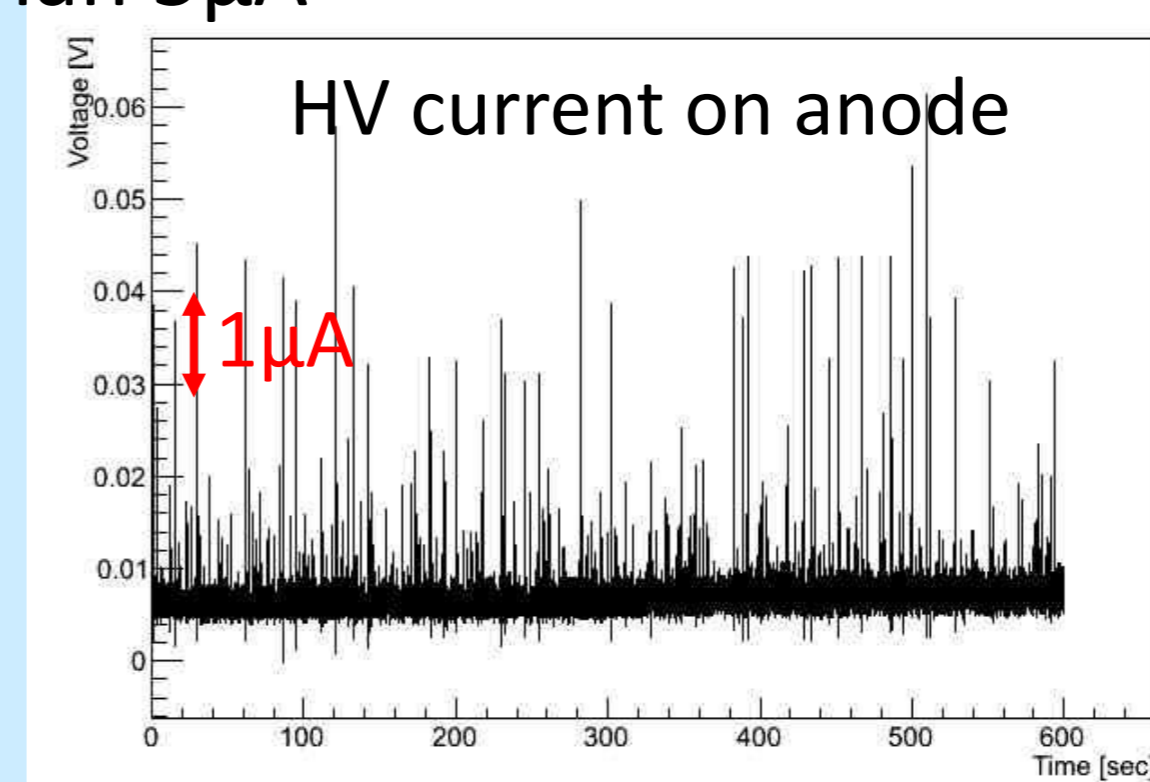
Beam time: June 17-23

Be(d, n)B reaction was used by tandem electro-static accelerator in Kobe University.

- Test in similar condition at ATLAS cavern.
- Neutron intense is about 10^5 cps/cm².
- Main neutron energy is about 2.5MeV

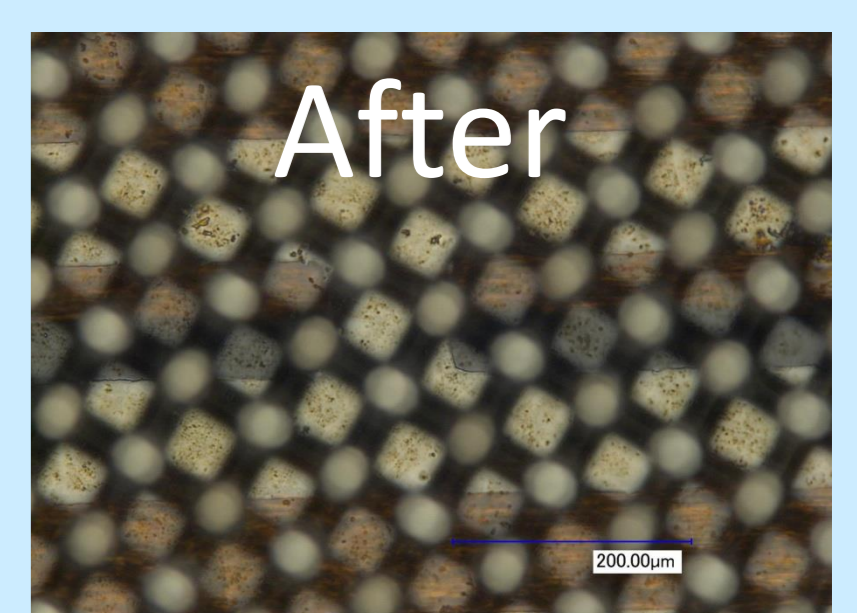
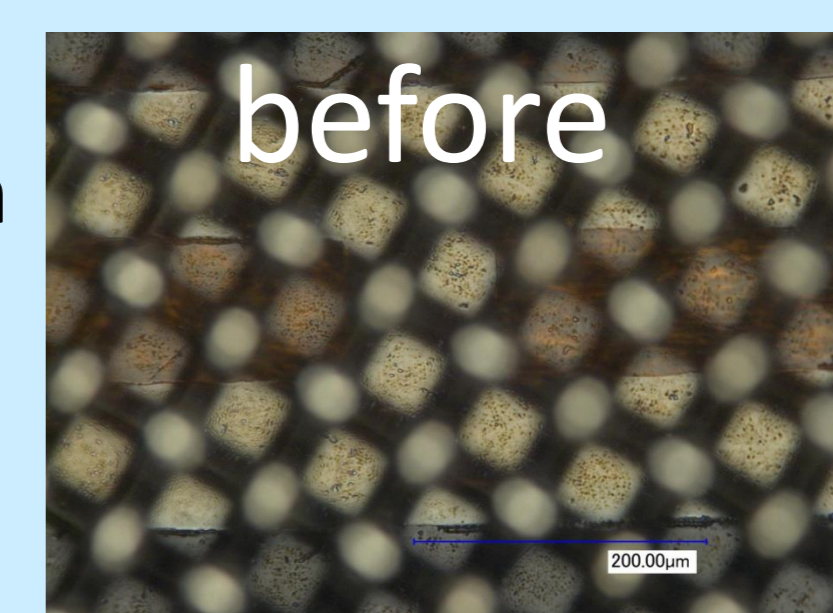
HV current on resistive anodes were measured

- However almost all of spark current are less than 5 μA



Before and after test

- No difference is observed on the resistive strips condition between before and after neutron test



Conclusions

- MPGD electrodes using sputtering has been proposed firstly.
- First prototype of MicroMEGAS using sputtered resistive electrodes are produced and tested, for ATLAS NSW detector development.
- It works as same as conventional resistive strip MicroMEGAS
- There is no damage after spark (big pulse) operation using neutron