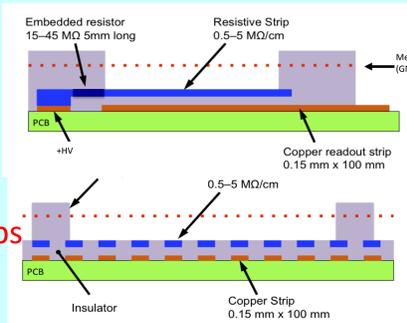


Development of MicroMEGAS using sputtered resistive electrodes for ATLAS upgrade

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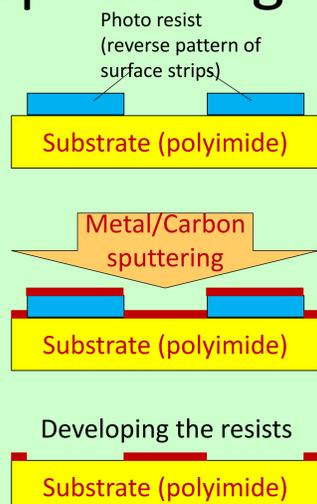
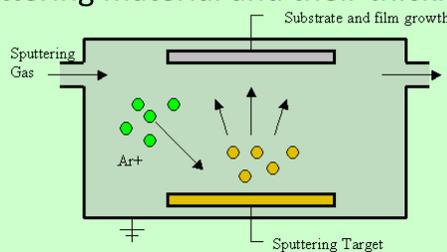
Requirements for ATLAS NSW MM

- 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



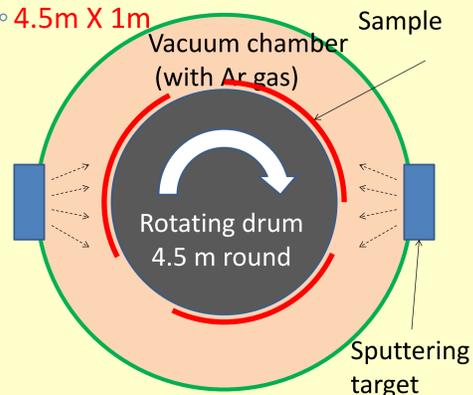
Liftoff process using sputtering

- 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



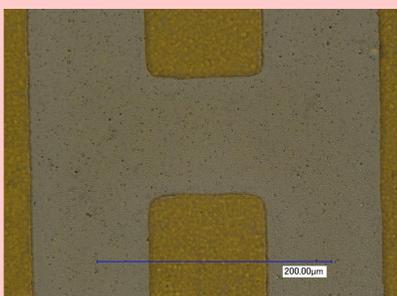
Sputtering facilities

- Large size sputtering is available.
 - 4.5m X 1m



Prototype of resistive strips

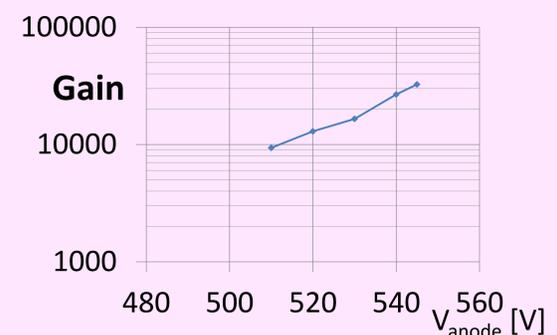
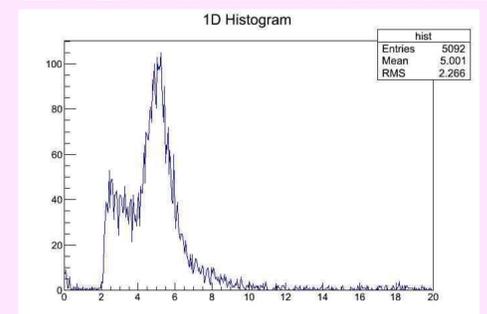
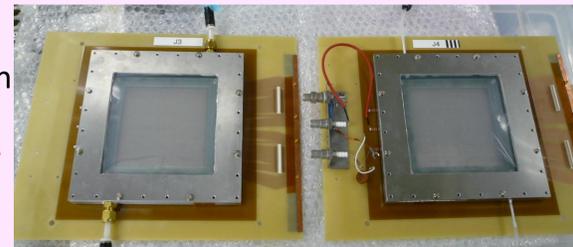
- Fine strip pitch of 200 μm is formed on 25 μm polyimide foil.
 - More fine structure will be available.
- Surface resistivity is 2M – 10M
 - Depend on carbon thickness
- It keeps strong adhesion and stability



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

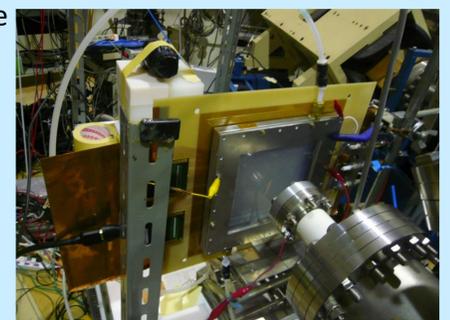
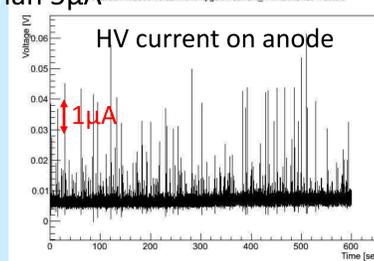
First operation test for sputtering MicroMEGAS

- 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

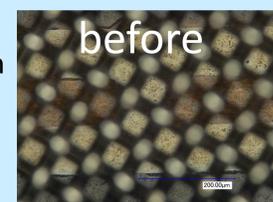


Neutron test for spark studies

- 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