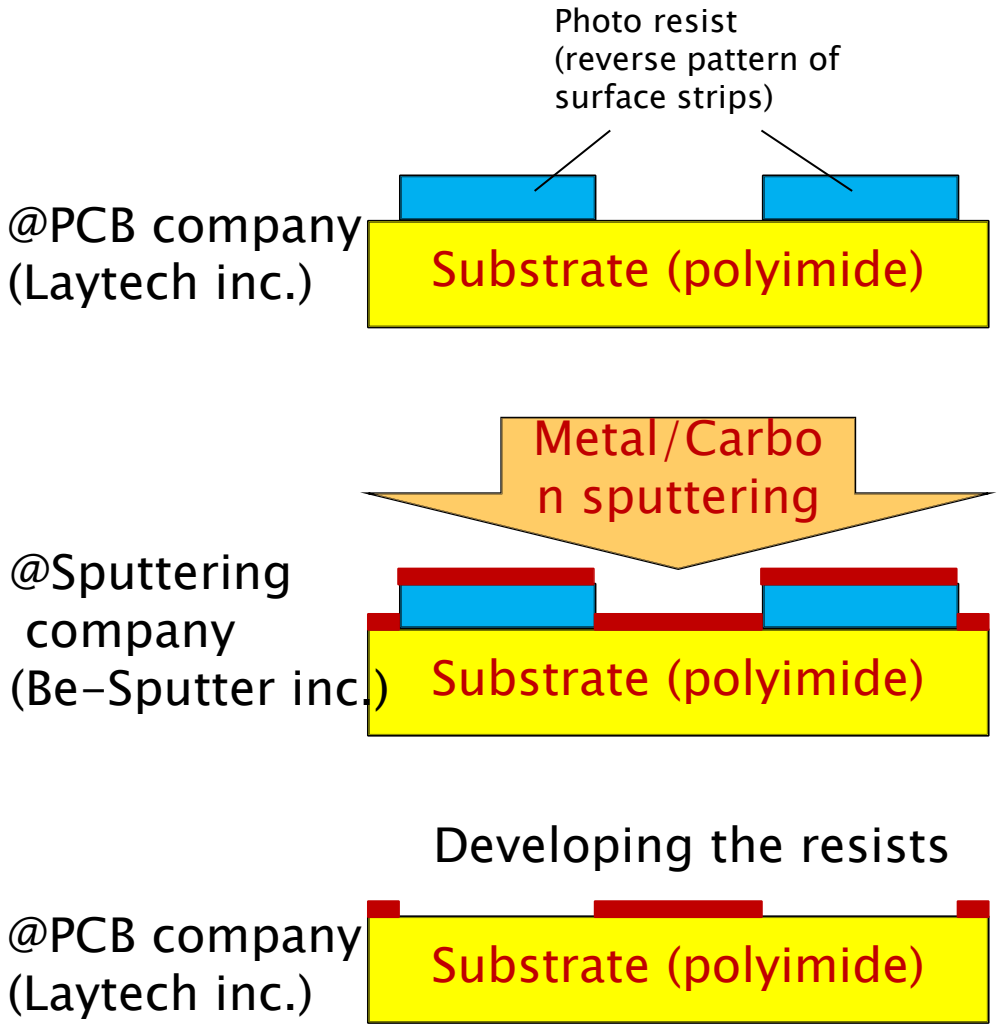
Industrialization on Resistive strip deposit

Atsuhiko Ochi
Kobe University

19/04/2013 New Small Wheel MicroMegas Mechanics and layout Workshop

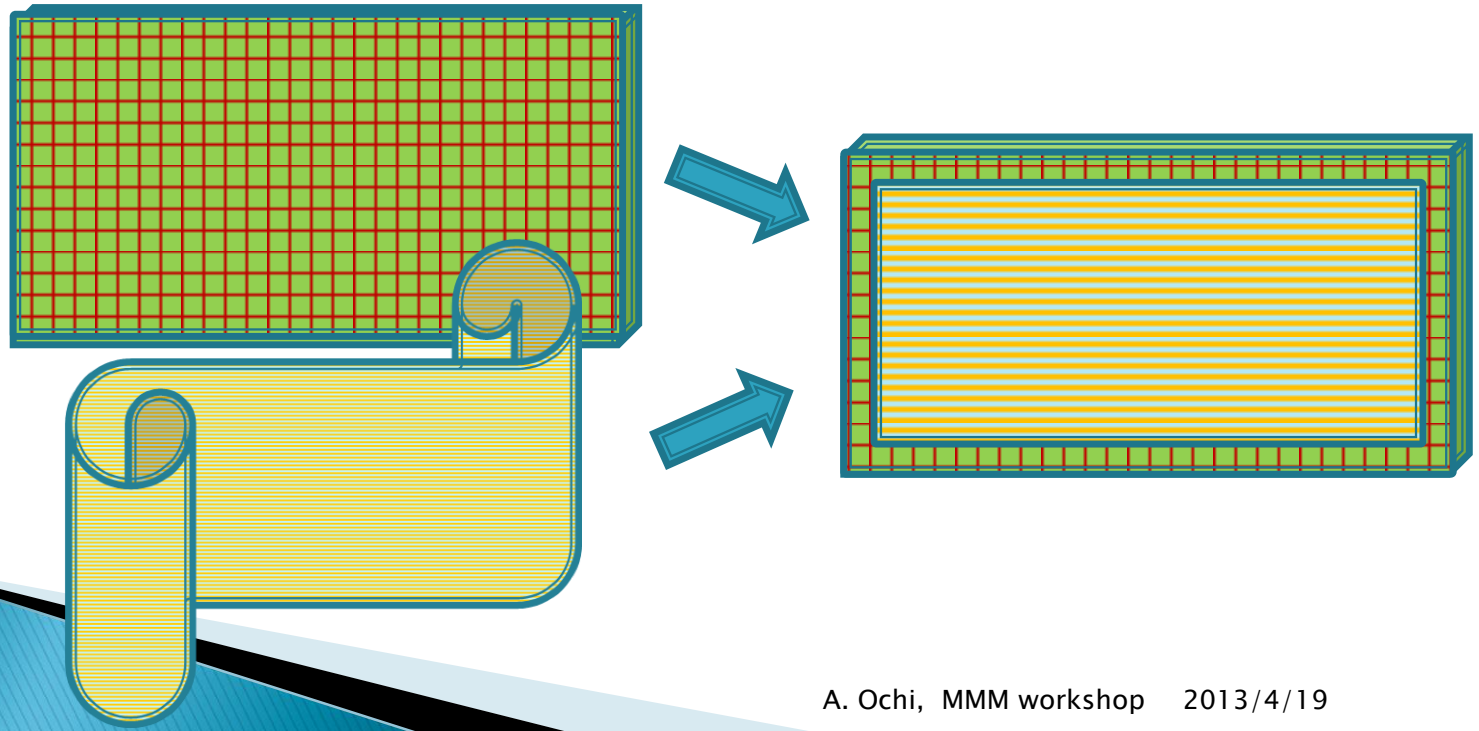
Liftoff process using sputtering

- 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



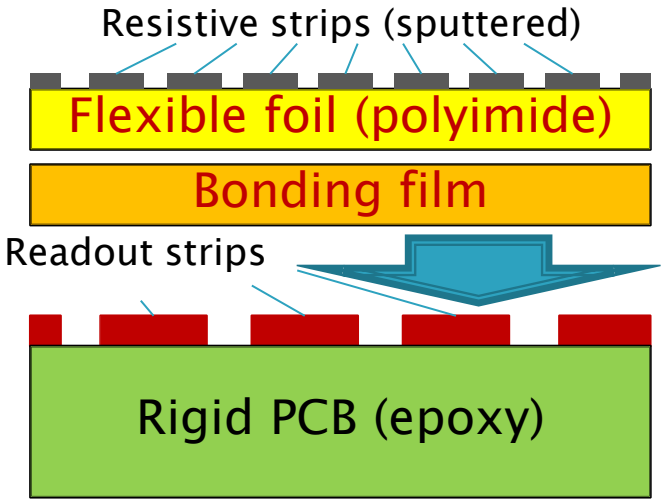
MM PCB production with parallel process

- We can divide the production process of resistive strip from that of readout board.
  - Resistive strip is formed on thin foil
  - Because of fine pitch, < 200 micron, we don't need fine alignment between resistive strips and readout strips.
- Dividing those processes will make the yield of production growing up.

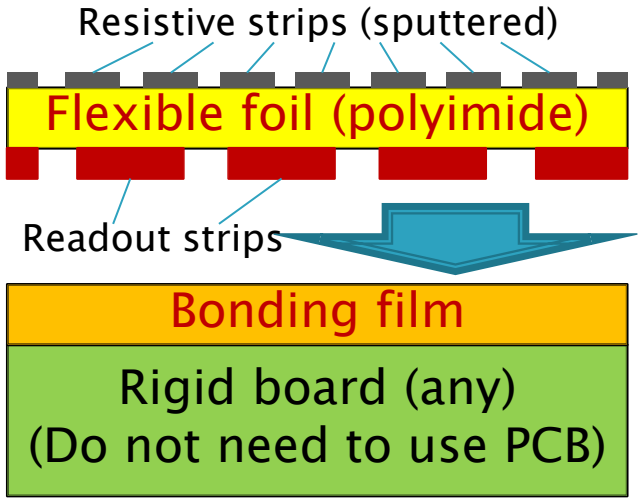


Two options for resistive strip deposit

1. Only resistive strips are on the flexible foil
   - Readout strips are on the rigid board
   - Substrate thickness is more than 50 μm (polyimide base and glue sheet (35 μm))



2. Readout strip patterns are printed on the rear side of flexible foil
   - No need to make fine strip on rigid board
   - Thin substrate thickness (< 25 μm) is available.



For patterning process

RAYTECH

- PCB company
  - They are expert for FPC (Flexible Printed Circuit) production.
  - Liftoff is basic process for FPC production

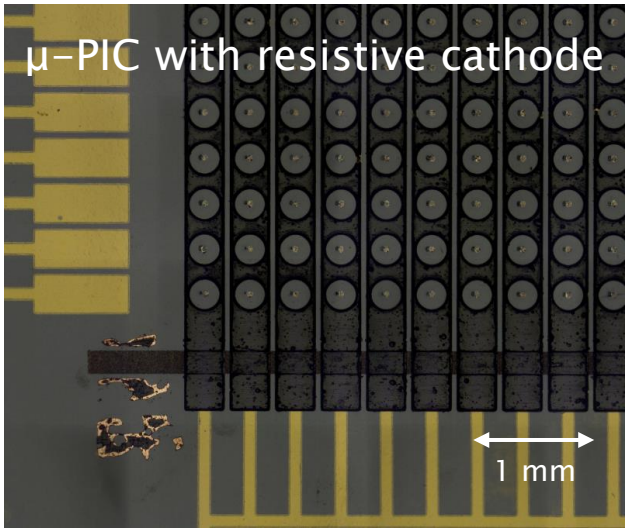
Exposure machines in clean room

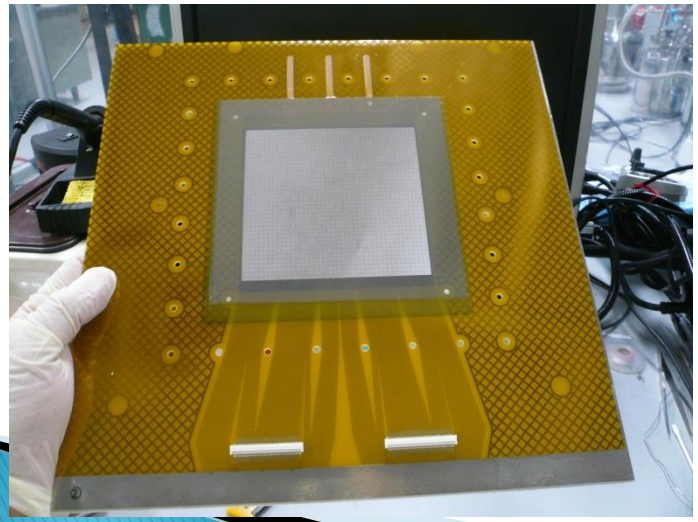
Electro forming machines

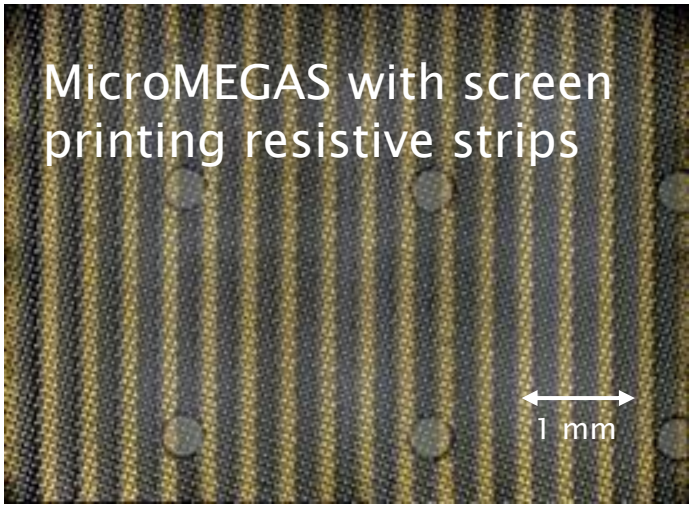
Etching machines

Fine patterning for MPGDs

- Laytech inc has many experiences for producing MPGDs.
  - μ-PIC with resistive cathode
  - GEM with resistive foil
  - MicroMEGAS with screen printing technique





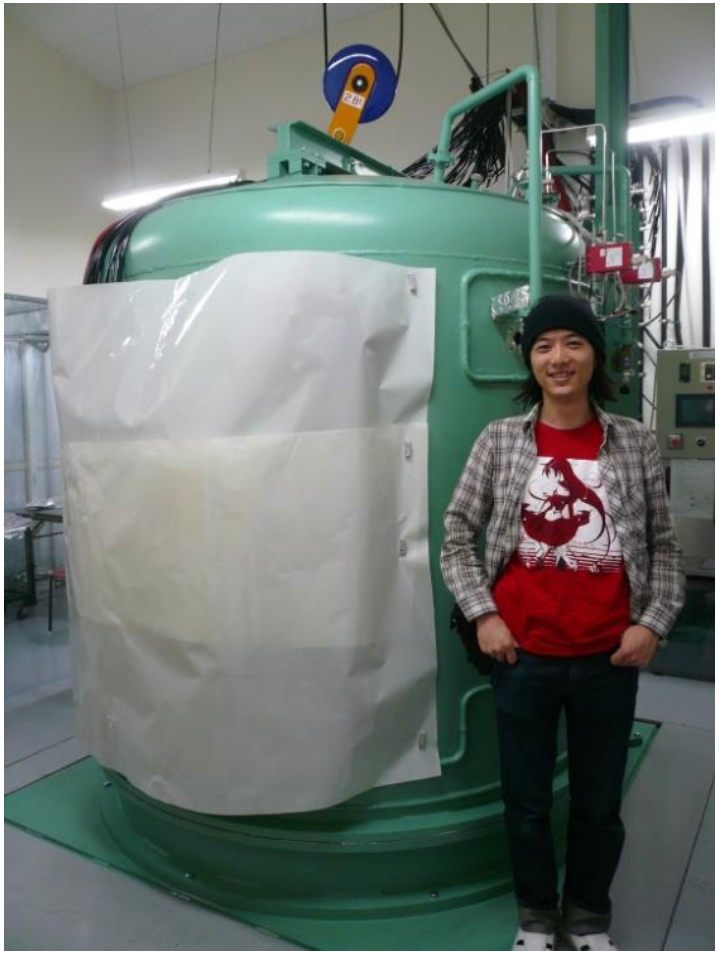


Be-Sputter

The door to the next generation is nanotechnology.

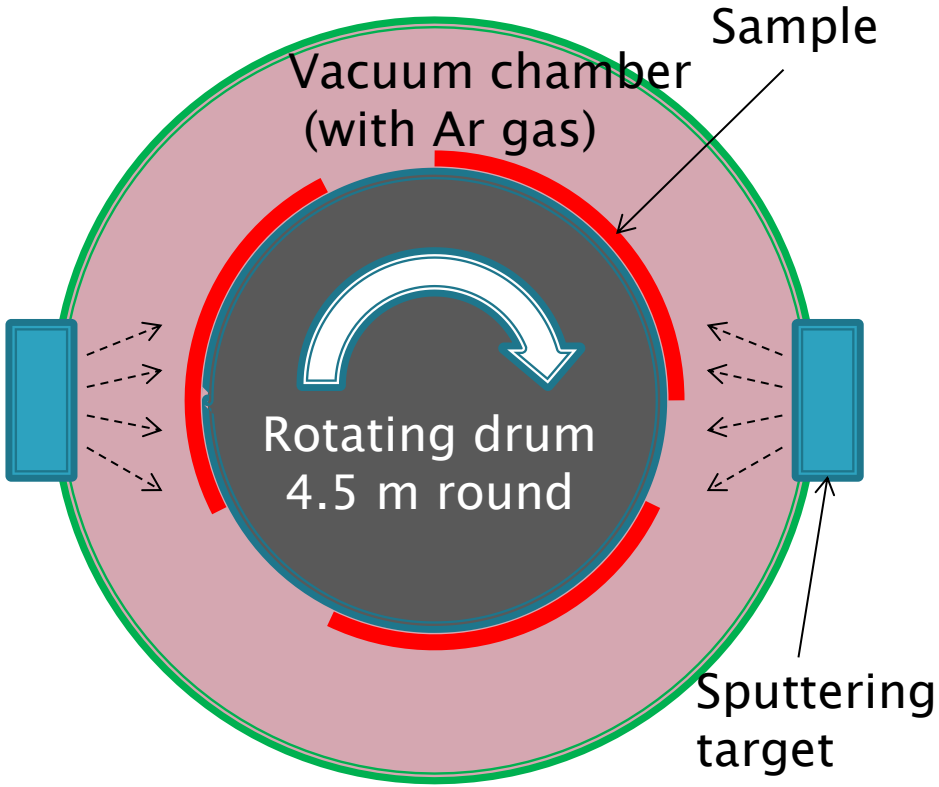
株式会社 ビースパッタ

- Sputtering company
- They have large sputtering chamber
  - Φ1800 X H2000
  - 1m X 4.5m (flexible board) can be sputtered
- They have special technology for uniform sputtering for large area



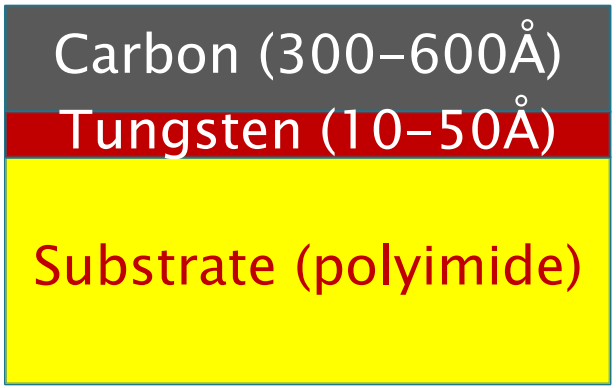
Sputtering equipment

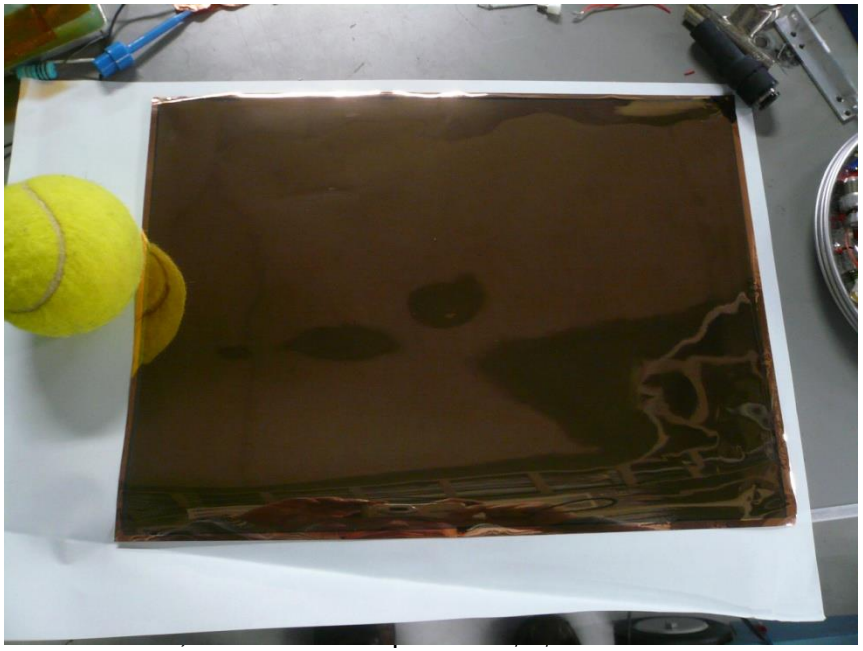
- Large size sputtering is available.
  - 4.5m X 1m
- Two layer stack sputtering is available
  - Using two separated target
- Very good uniformity
  - Less than nm size difference, using their special technology



Sputtering with resistivity

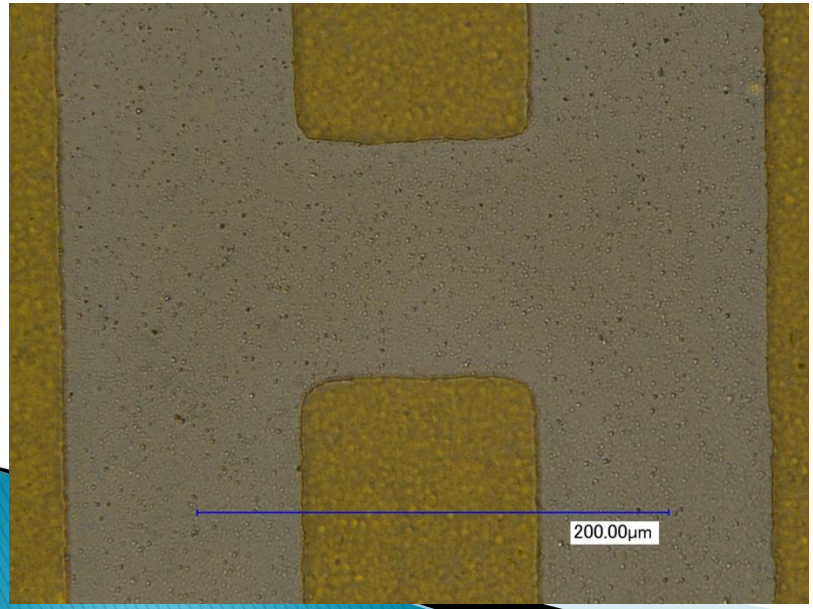
- Tungsten and Carbon are sputtered on polyimide (25μm thickness) foil
  - Surface resistivity of first sample (W 10Å, C 300Å) was 8MΩ/sq.
  - Adhesion of coating is very strong. No resistivity change with rubbing surface by cleaning paper.
  - No resistivity change found after long exposure (1 week) to air





Fine patterning with lift off process

- Fine strip pitch of 200 μm is formed. It will be possible to make more fine structure.



Mass production feasibility

- Assumption:
  - Size of foils: 1000mm x 500mm
  - Quantity: 3000
  - Sputtering: W:10Å, C:600Å
- 500 foils / month can be produced
  - 8 foils can be sputtered simultaneously in one batch.
  - Sputtering time is estimated 2 hours.
    (Including overhead, 3 hours / one batch)
  - 24h/3h x 8 foils x 20days = 1280 foils / month
    (Applying safety factor >2 → 500 foils/month)
  - It will take half year, for full production.
- Cost estimation (Very rough)
  - 100k JPY / one batch (for spattering 8 foils)
    (13k JPY / foil)
  - It is not sure for the cost of liftoff process,
    but it is estimated around 20k JPY/foil
  - Total 33k JPY/foil, 100M JPY for full production