Development of Large Area Resistive Electrodes for ATLAS NSW MicroMegas

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Two options for resistive electrodes

- **Sputtering+liftoff**
  - **Pros.**
    - Large area (>2m)
    - Fine pattern (<10μm)
    - Precise pattern (<1μm)
    - Uniform resistivity
    - Strong attachment on substrate
  - **Cons.**
    - High cost

- **Screen printing**
  - **Pros.**
    - Large area (>2m)
    - Fast production speed
    - Low cost for mass production
  - **Cons.**
    - Thick pattern (~20 μm)

**Production procedure**

1. **Design of Resistive strips**
   - Carbon sputter (SM2)
   - Screen printing (SM1/LM2)

2. **Production**
   - Substrate (polyimide)
   - Photo resist (reverse pattern of surface strips)
   - Sputtered Carbon
   - Polyimide film is attached to vacuum table with porous sheet

3. **Developing the resists**
   - For sputtering (SM2) 30 foils
   - For screen print (SM1)

4. **Printing quality (Resistivity)**
   - Dependency on Line/Strip width on screen
   - Prototype resistivity measurements
   - Screen is set on printing machine
   - Resitive ink: ESL RS42100 series

5. **Surface resistivity measurements**
   - Screen printing quality (Resistivity)

6. **Print pattern of resistive strips**

**Requirements for ATLAS NSW MicroMEGAS**

- High position resolution for eta direction
  - <100 μm for eta direction. (Resolution of a few mm is allowed for second coordinate.)
- Tolerant for high rate HIP particles
  - ~ 15kHz/cm² neutron / γ cause sparks
  - Resitive strips should be formed with Resistivity of 10~40MΩ/cm to reduce damage of the sparks
- There should be a technology for large size production (~2m)
- Mass production should be available
- Low cost

**Module – 0 production** (Prototype for mass production)

**Structure and sizes of modules**

**We have succeeded to produce large (Module-0) foils using both technologies**

**Summary and Future prospects**

- Resistive electrodes of large area MM are developed by two different way: Sputtering and Screen printing.
- Both of them have enough quality for ATLAS NSW.
- We choose Screen print technique because of lower cost.
- Now, Module-0 is under construction.
- Series production of resistive foils will be started from December 2015.