



核数据重点实验室

The Progress of GEM foil at CIAE

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Outline

- The progress of GEM foil at CIAE
- Other developments

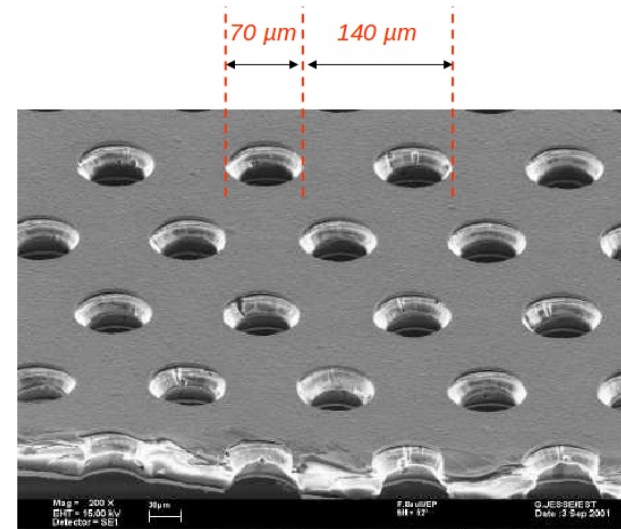


The Progress of GEM Foil at CIAE

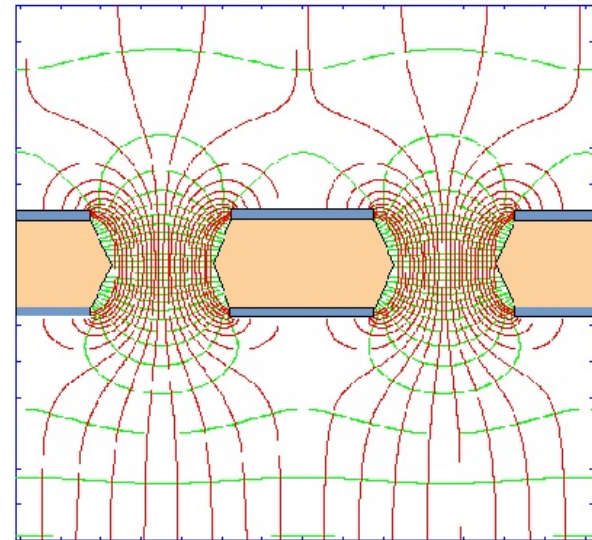


GEM Foil Structure

1. Typical GEM Foil has 3 layers, two $5\mu\text{m}$ thick copper foils and one $50\mu\text{m}$ thick kapton foil in the middle.
2. Diameter of the hole is $70\mu\text{m}$, and the distance between them is $140\mu\text{m}$.
3. Apply electric voltages on the two copper layers.
4. Electric Field is very strong in the hole area, and weak outside the hole area.

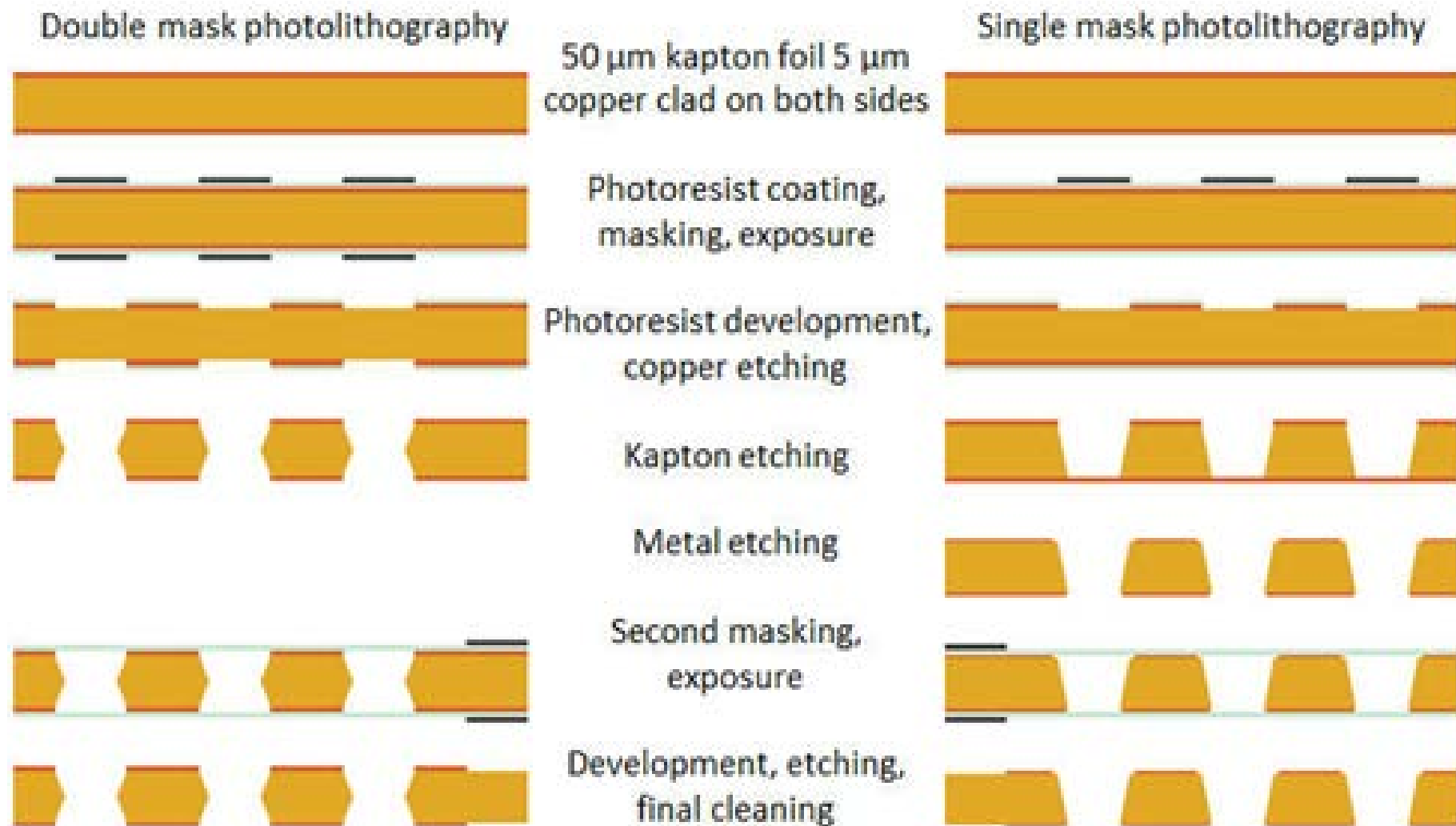


GEM Foil

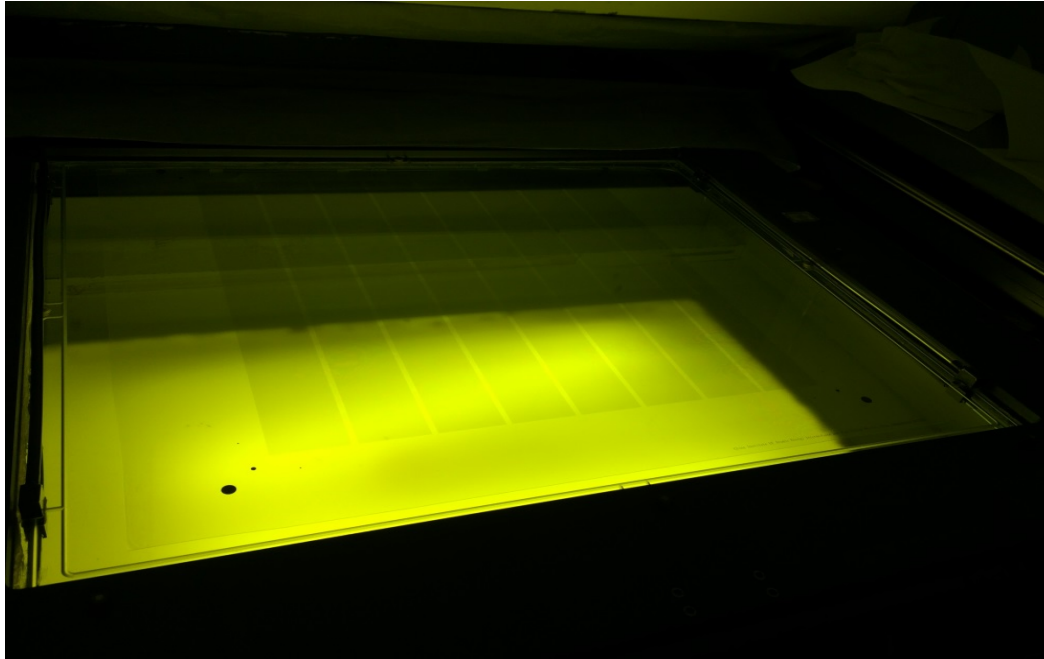


GEM Field

The Procedure of GEM Foil

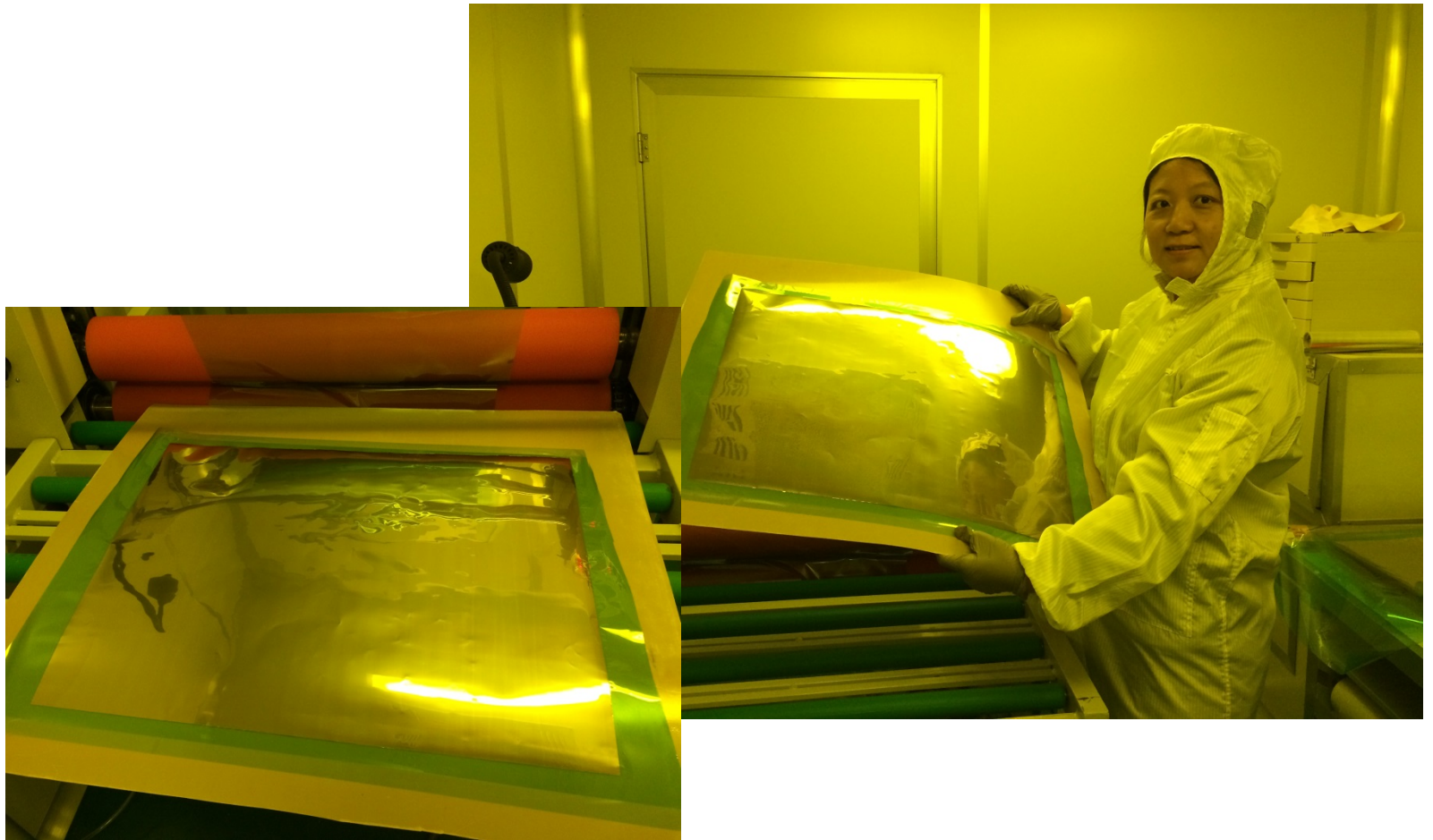


GEM Photo Mask Plate



The copies of the photo-mask are done by photolithographic techniques.
40cm*40cm photo mask is produced.

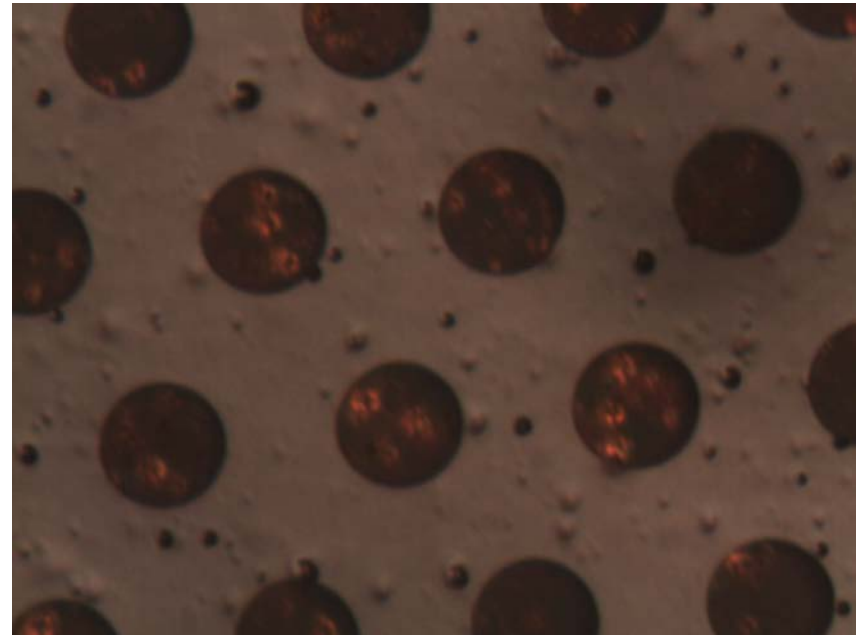
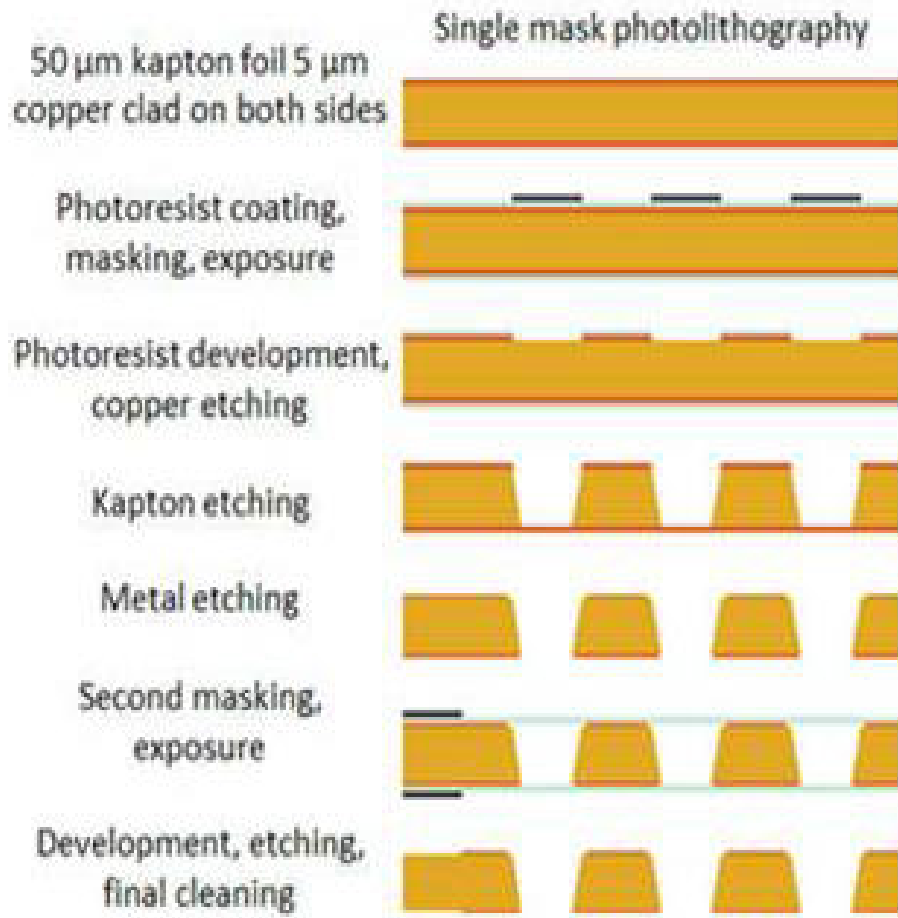
Lamination of Dry Film Photoresist



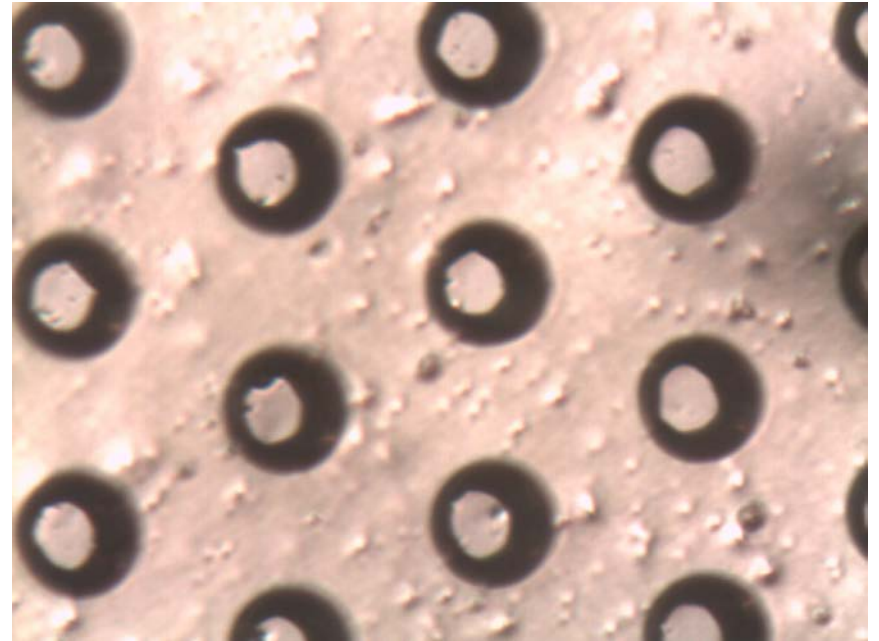
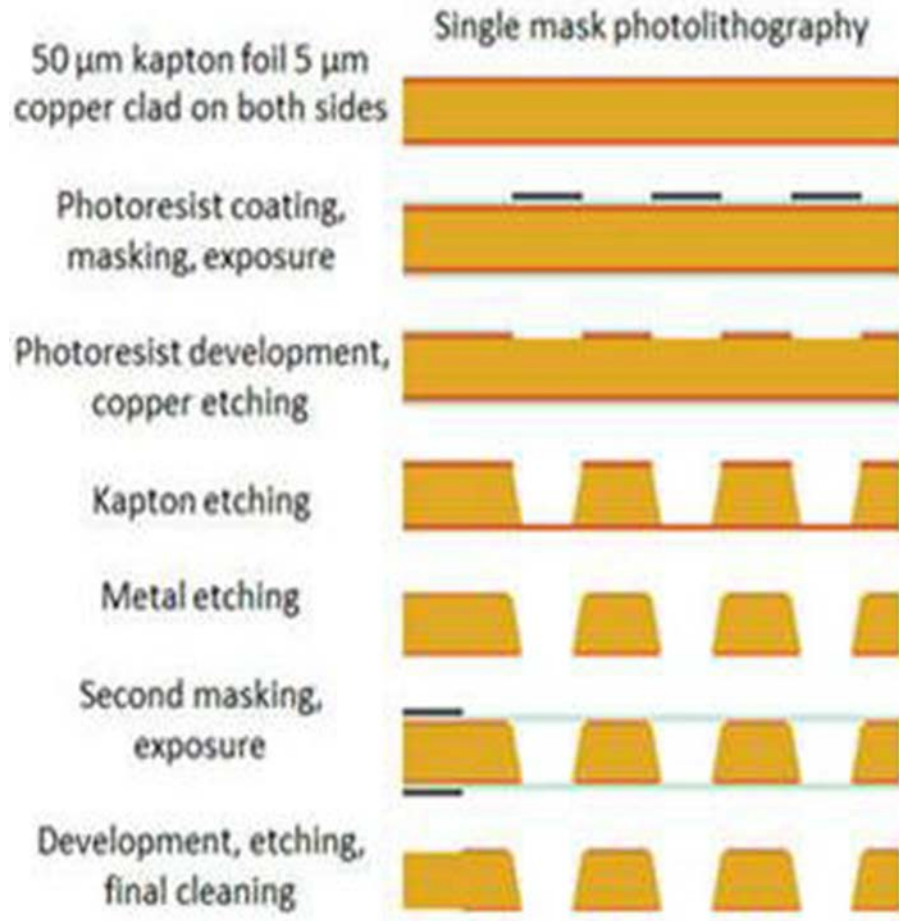
Exposure of Dry Film Photoresist



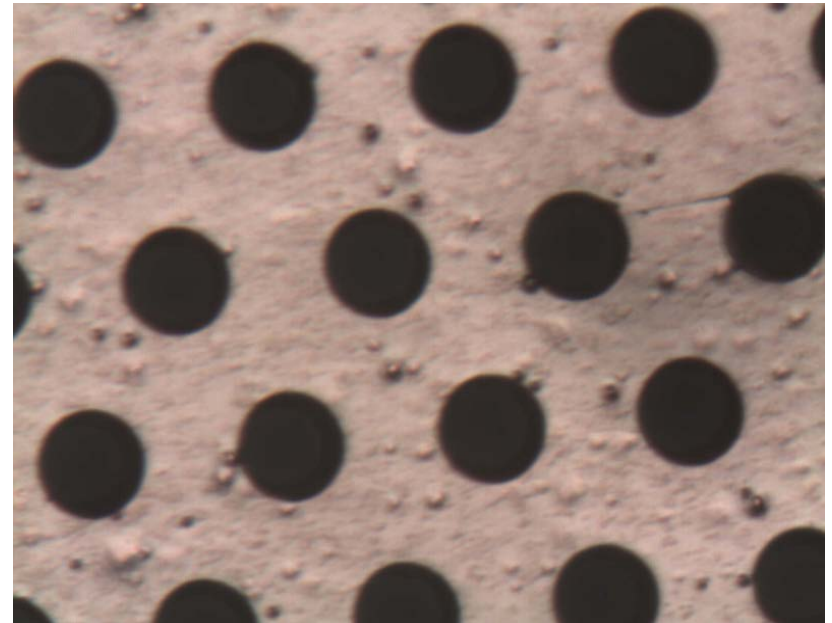
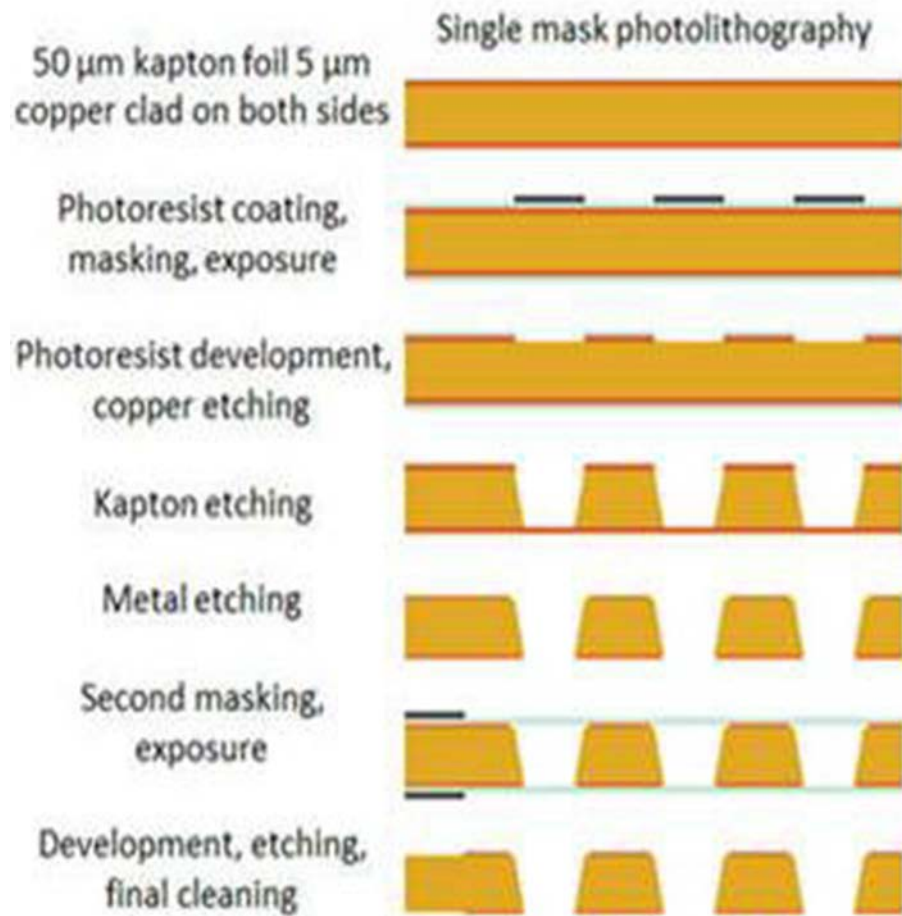
After First Copper Etching



After First Kapton Etching



After Second Copper Etching

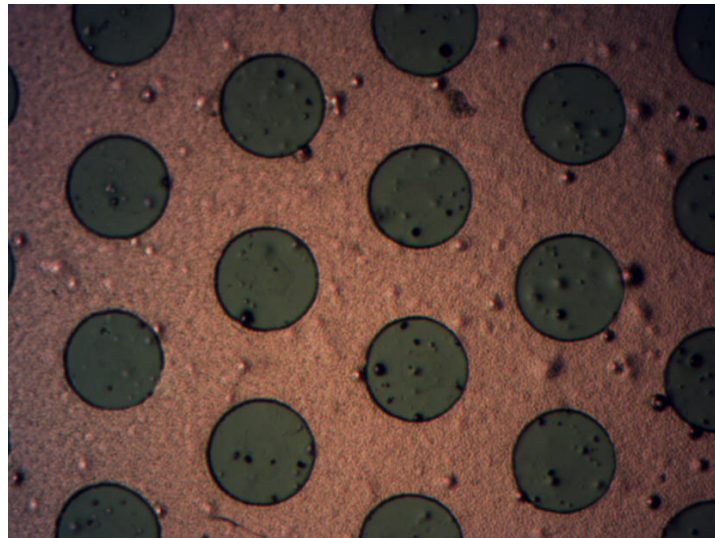
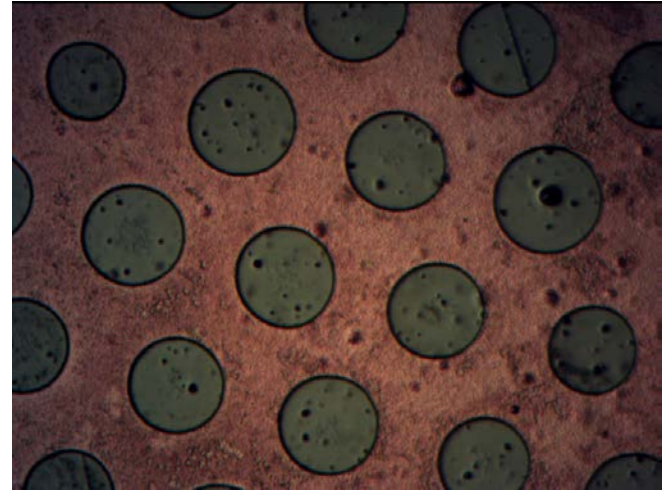
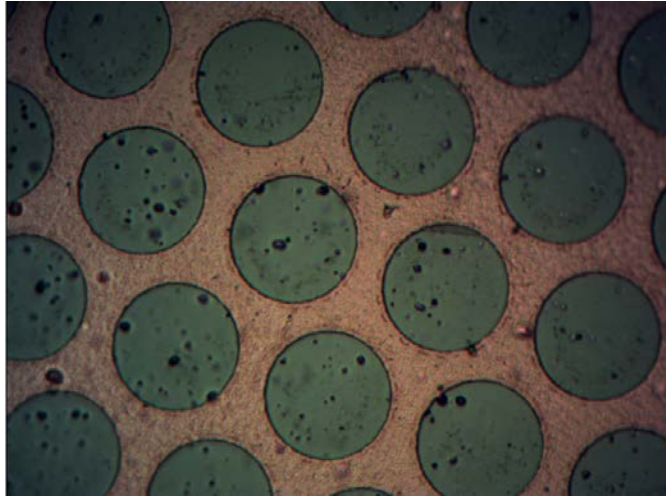


40cm*40cm GEM Foil

- The 40cm*40cm GEM foils were made successfully.
- Single-mask method was used.



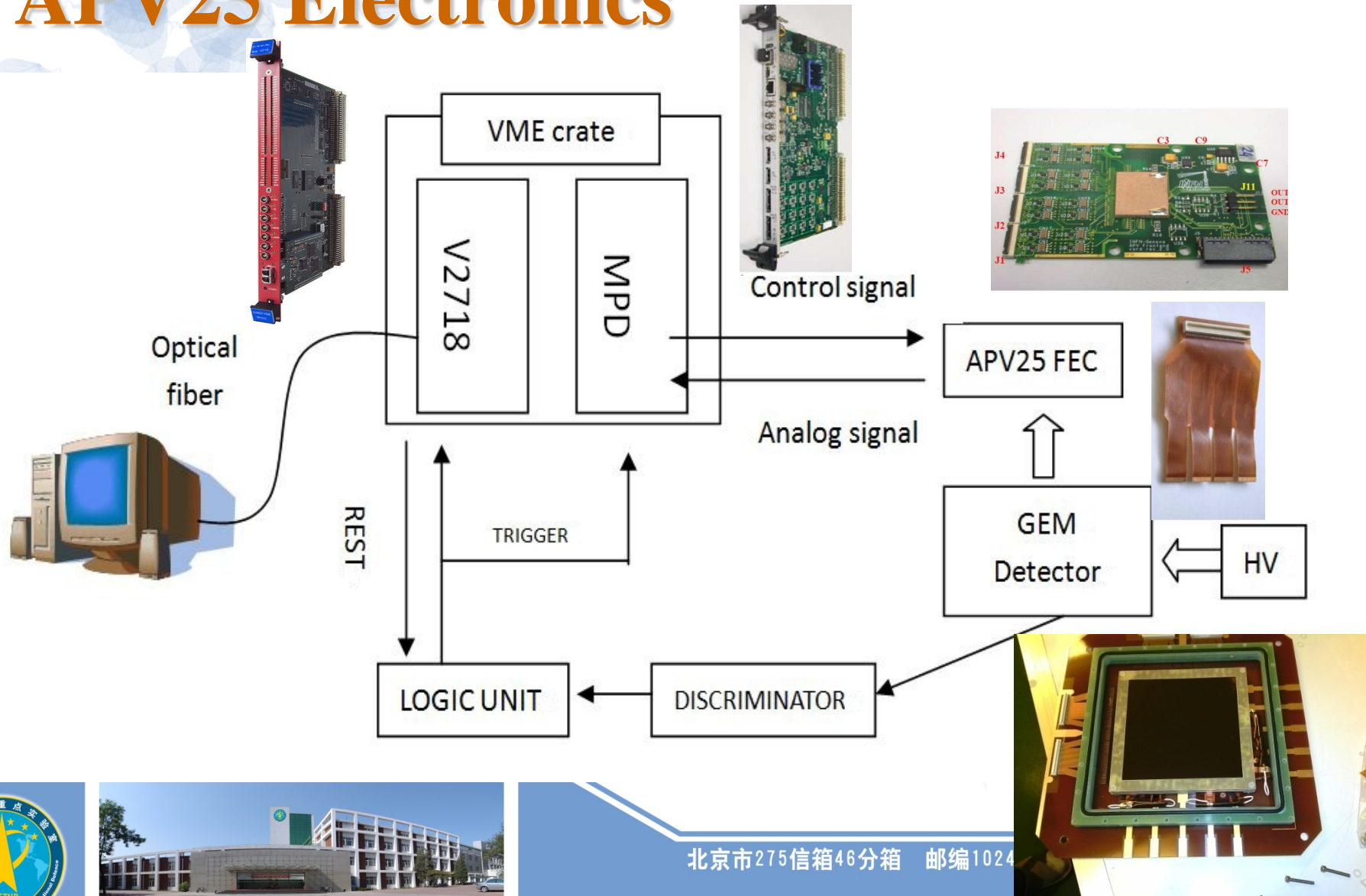
New Chemical Reagents



Other Developments



GEM Test system with APV25 Electronics



Spatial resolution

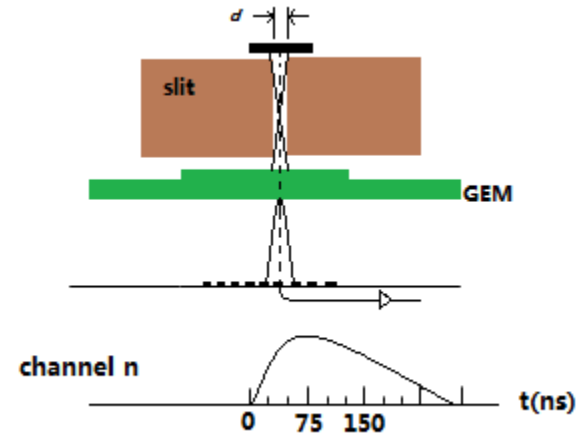
$$\sigma_{\text{tot}}^2 = \sigma_{\text{GEM}}^2 + c_1 \sigma_{\text{geometry}}^2$$

When: $\sigma_{\text{geometry}} \ll \sigma_{\text{GEM}}$

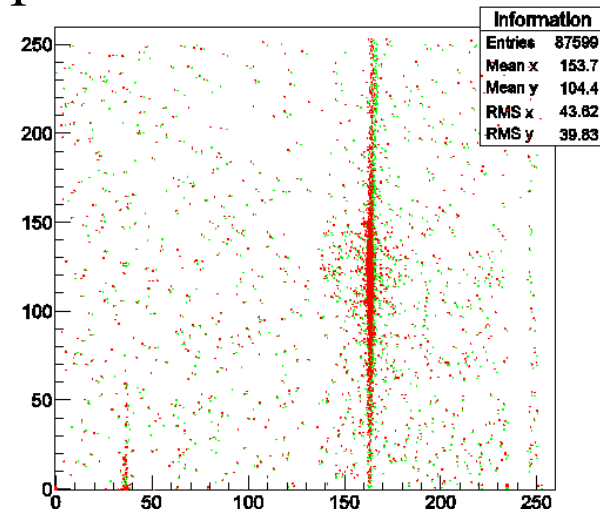
$$\sigma_{\text{tot}}^2 \cong \sigma_{\text{GEM}}^2$$

- Slit(um): 20;
- Ar: CO₂=70% : 30%;
- HV: 3600V;
- The distance between strips: 400um;

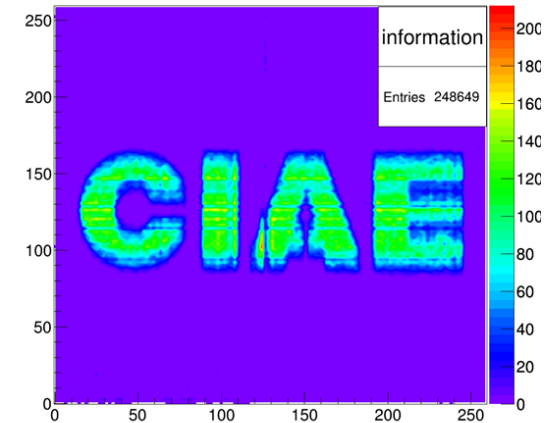
$$\varepsilon = 19.6\%$$



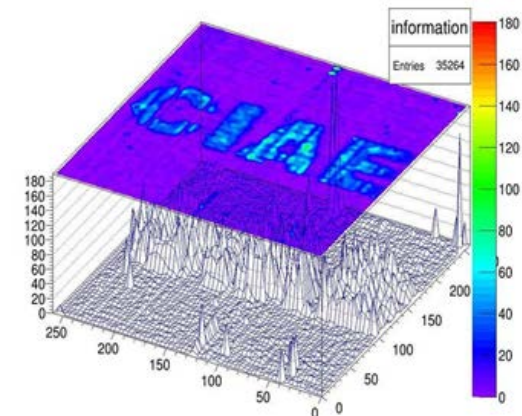
Spatial resolution $\approx 76\mu\text{m}$



X-ray imaging @ CIAE



- X ray Energy: 8.9KeV;
- about 1k sample rate
- 256 channels for each dimension(512 channel in total);
- 4 APV FECs were used (2 for each dimension)



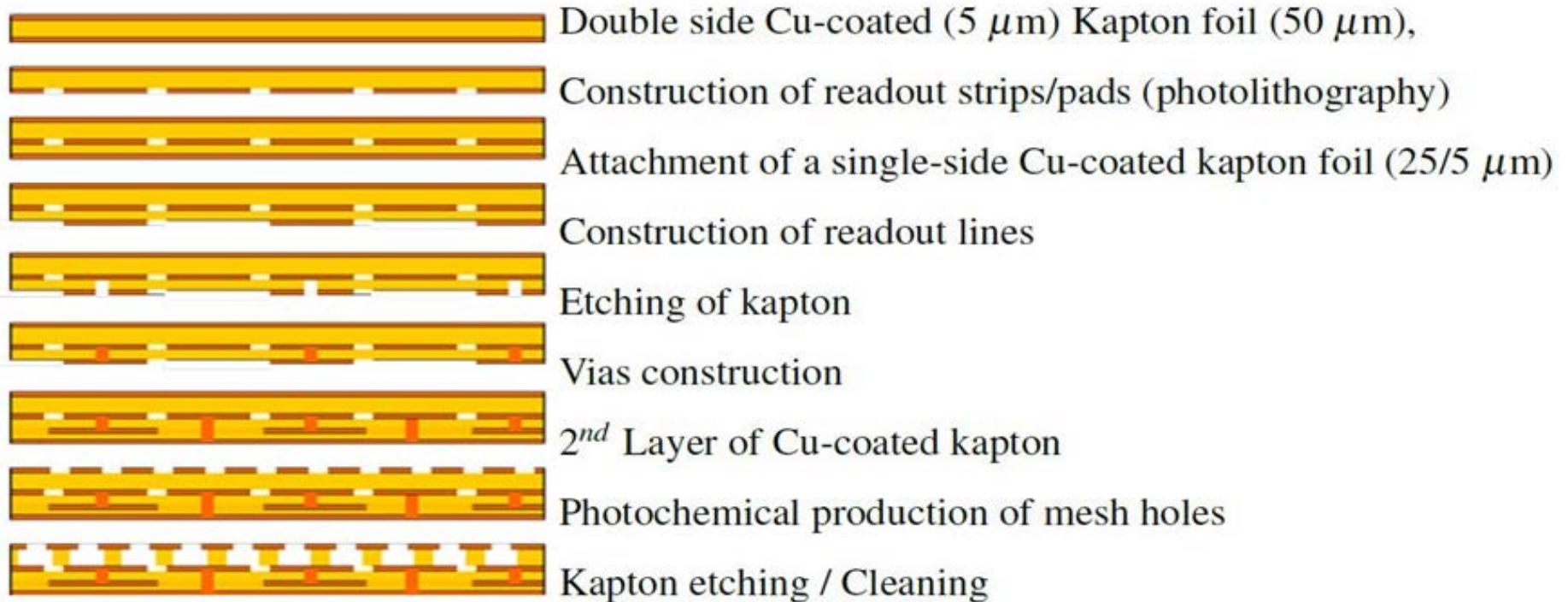
北京市275信

传真69357787

Microbulk Micromegas

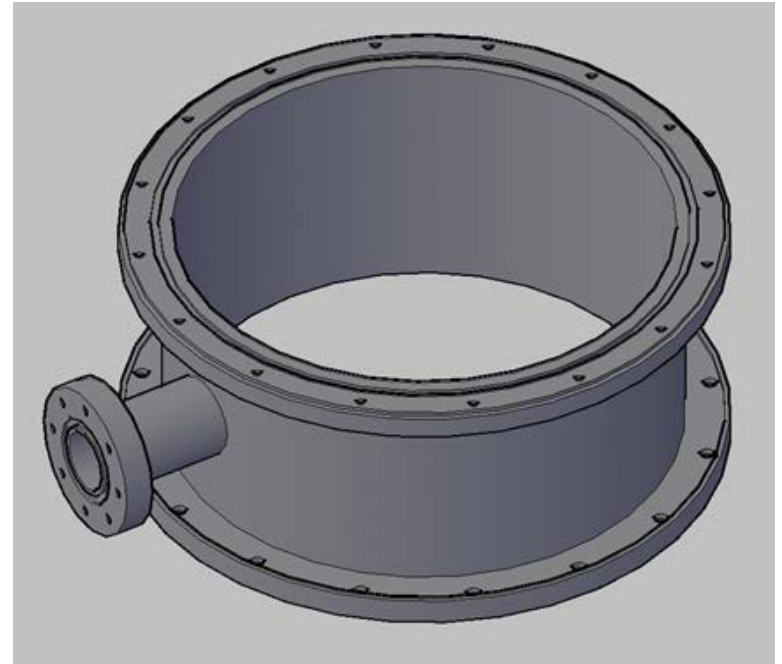
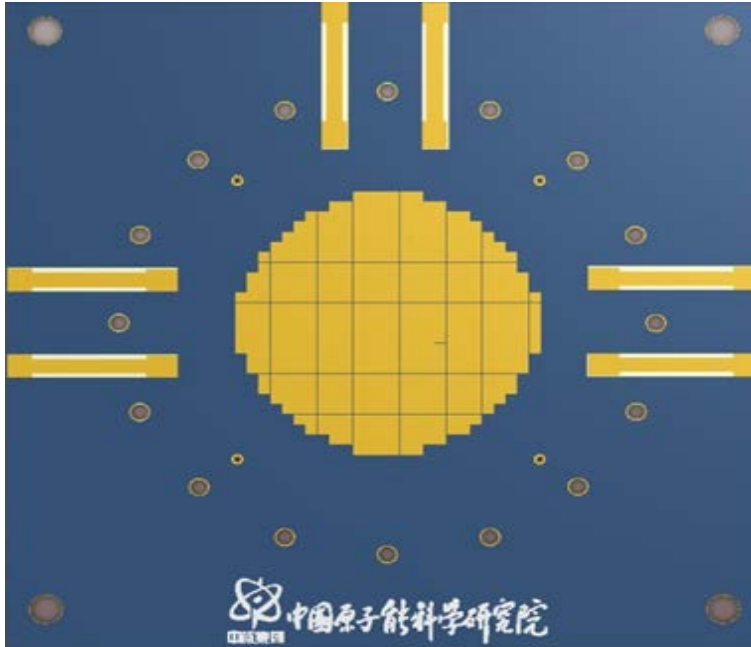
Fabrication Process

This technology is inspired by
the GEM detector fabrication process invented at CERN .



Next Step

New design of 20cm diameter round MicroBulk MicroMegas
Prototype: 0.5cm² pad, 512 APV25 electronics



总结与展望

- 在过去一年中，利用Single Mask技术研制出40cm*40cm GEM 膜。
- 完成GEM探测器APV25电子学测试和成像研究
- 准备进行用自己研发的GEM膜制成GEM探测器并进行测试。降低废品率。如果顺利的话，就可以尝试进行GEM膜小批量生产。
- 利用与GEM膜工艺非常相近的光刻蚀刻技术进行新型微网探测器研制。



感谢核探测器与核电子学国家重点实验室开放基金支持！

Thank You !

