

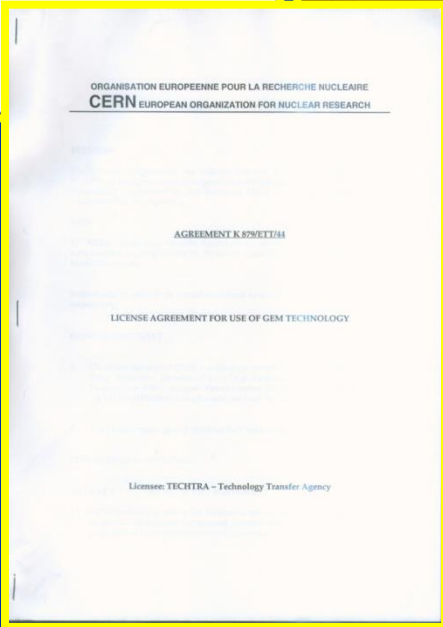
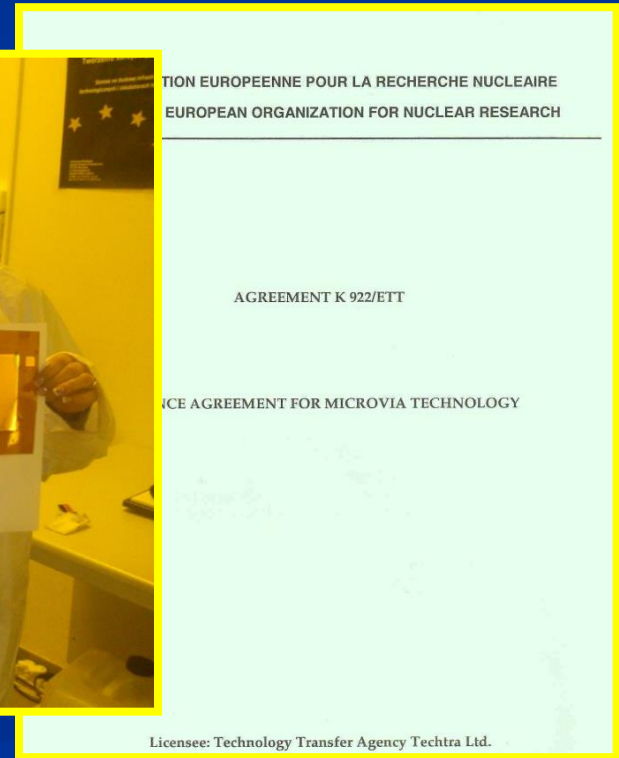
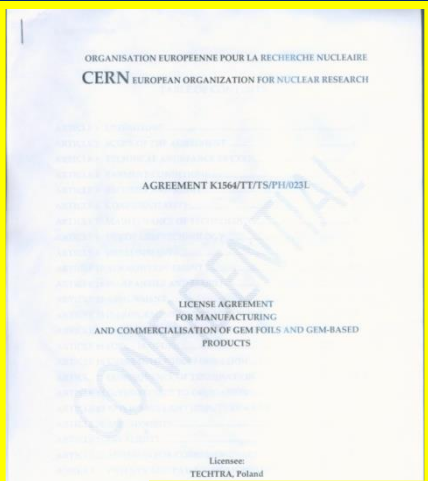


GEM production facility upgrade II

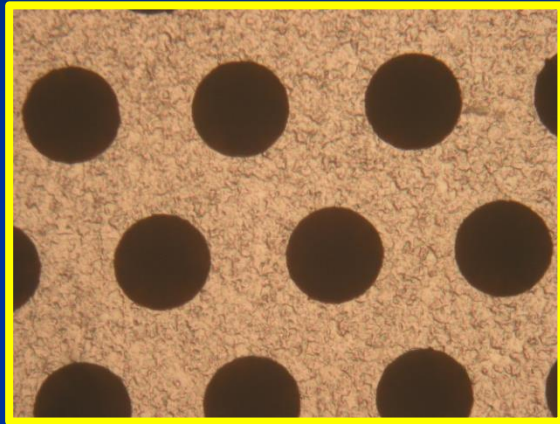
(RD51 Dec 2012 - RD51 April 2013)

Piotr Bielówka

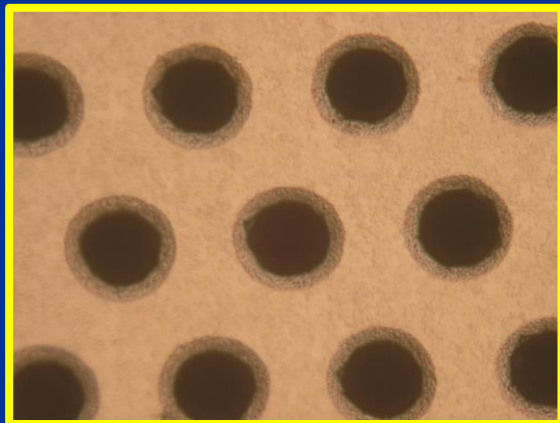
Introduction:



„Small GEMs“ manufacturing upon CERN
licence with “double mask”

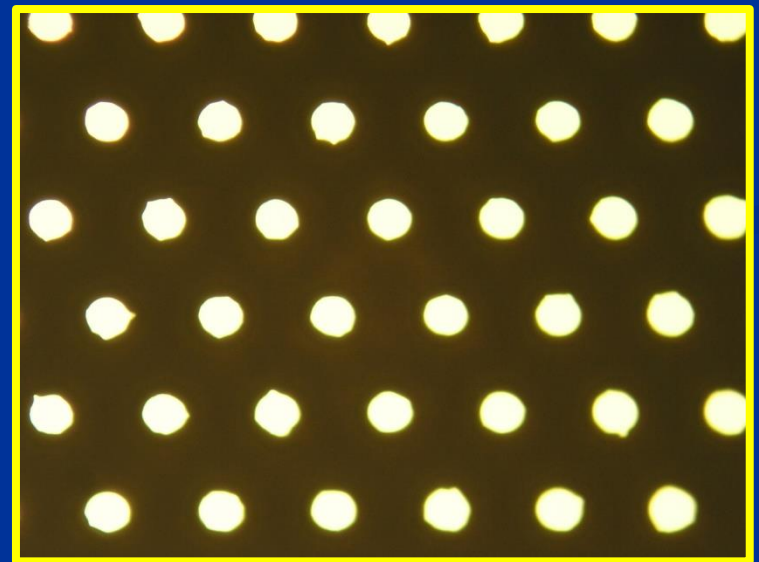


Side A



Side B

10x10cm GEM made with
„SINGLE MASK“:

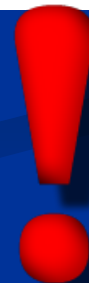
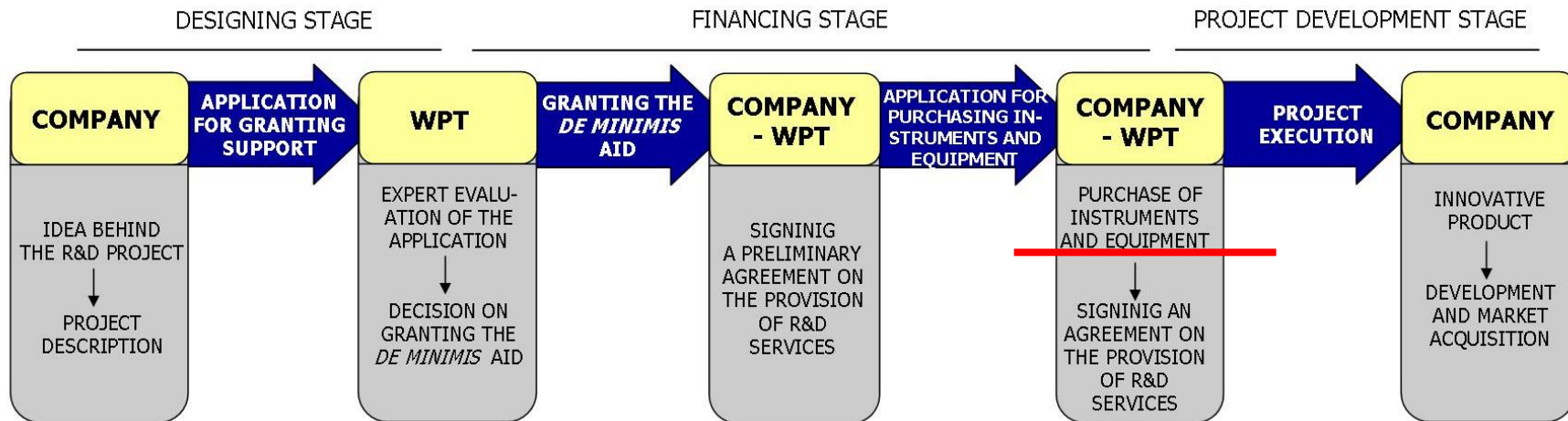


Problems caused by:







- Photorezist adhesion
- Reagents concentration

Towards Big GEMs:

„Research and development project“
- transfer of support from WPT to Techtra



Delivery Schedule (December 2012)

Machine	Producer	Delivery Time [weeks]	Status
Developer	WISE		NEW
Cu Etcher			
Kapton Etcher			
Washer			
Exposure	TECHNIGRAF		NEW
Microscope	OLYMPUS		NEW
Set of tanks for Stripping and Electro Etching.	MATUSEWICZ		NEW
Oven, Laminator, Others	MEMMERT and others		Second Hand
Civil Works	WROCLAW TECHNOLOGY PARK		NEW
GEM Diagnostics System	TECHTRA + NATIONAL CENTRE FOR NUCLEAR RESEARCH	Pending	NEW



Upgrade schedule:

1. Already delivered:

1. Technigraf exposure unit (working area 1,2x2m)
2. WISE Chemstar resist developer
3. WISE Chemstar rinser
4. WISE Chemstar copper etcher
5. WISE Chemstar kapton etcher
6. Memmert oven
7. Olympus microscope, diagnostic tables, demineralizator, ect.

Wet processing machines

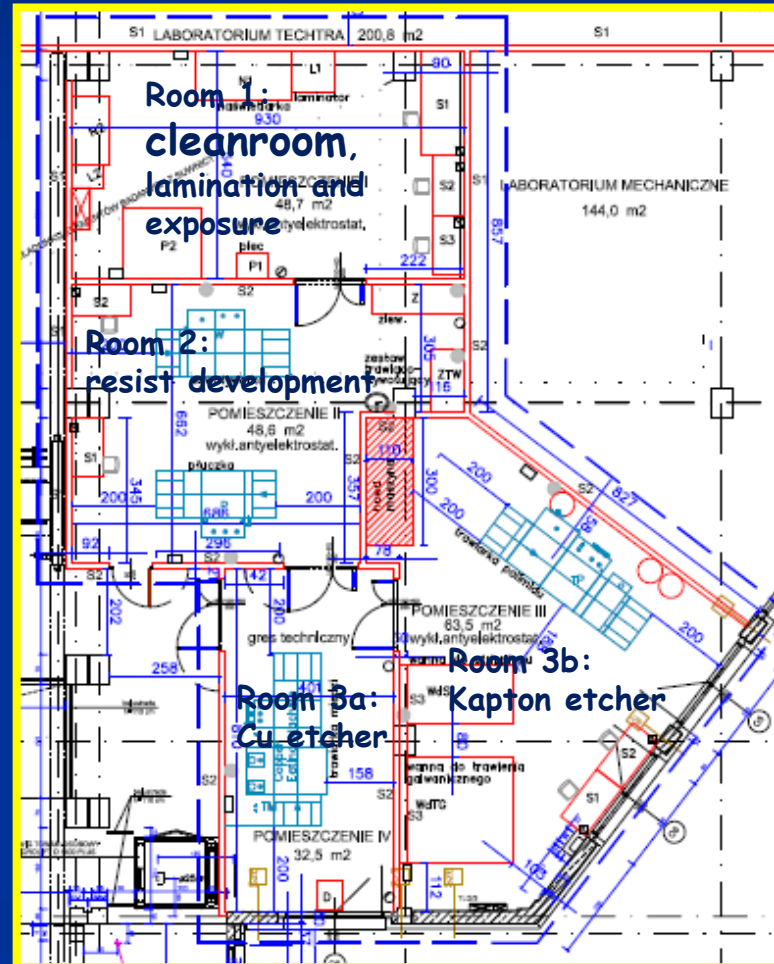
2. Scheduled for delivery:

1. Tanks for electrochemical copper etching and resist stripping
2. Photorezist laminator
3. ISO class 7 cleanroom unit for lamination and exposure

New workshop for „BIG GEMs”



Room 1 - 48 m²
Room 2 - 48 m²
Room 3 - 96 m²
Total - 192 m²



Wet processing equipment for „BIG GEMs”

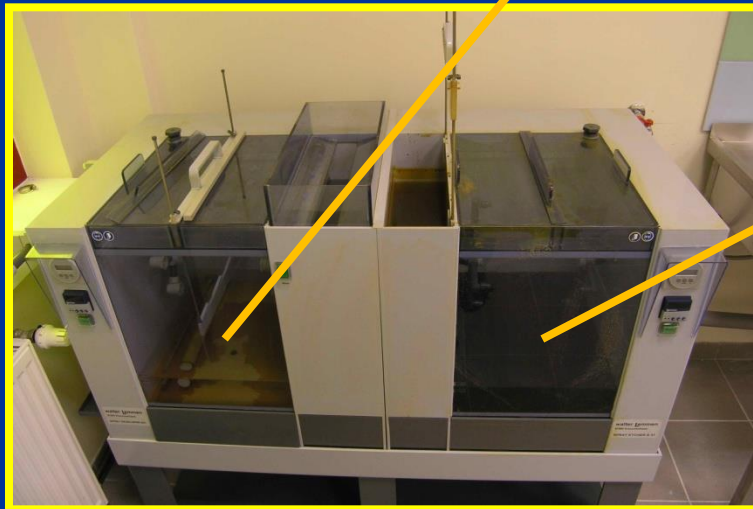
Old Kapton etching machine
GEM limitation (30x30cm)



New Kapton etching machine
GEM limitation (width 65cm)

Wet processing equipment
for „BIG GEMs”

Old developing
and etching set



New developer



New Cu etcher

New machinery for „BIG GEMs”



Optical measurement stand.



Current optic microscopes set.

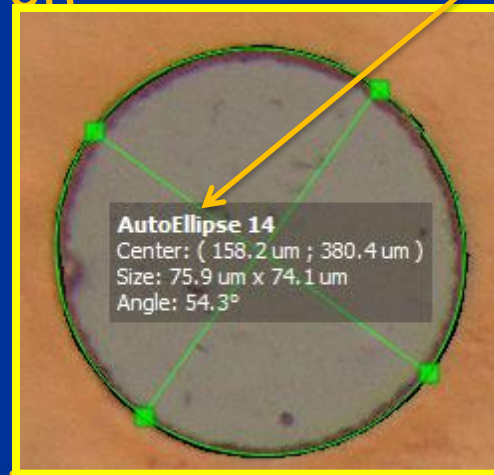


Additional optic microscope.

RD51, CERN, April 2013

Developed software to measure openings:

- To tune copper etching we needed a tool to measure many hole diameters simultaneously.
- We have developed software to automatically:
 1. Detect hole borders on images from microscopes
 2. Fit ellipses to detected contours
 3. Report statistics of hole size and uniformity



Measurement Results

Measures of:
C:/Janek/Eksperymenty/gem_o46/gem1/raw_img/topPG_x10.jpg
on Thu Feb 14 16:48:14 2013

Per-hole measurements:

A.El. 1:	74.0x74.8, r=1.011
A.El. 2:	74.8x76.1, r=1.017
A.El. 3:	72.9x74.6, r=1.023
A.El. 4:	72.0x74.3, r=1.031
A.El. 5:	71.7x74.5, r=1.038
A.El. 6:	73.4x75.0, r=1.021
A.El. 7:	73.1x74.8, r=1.023
A.El. 8:	74.0x75.4, r=1.019
A.El. 9:	71.6x74.3, r=1.038
A.El. 10:	71.9x74.0, r=1.029
A.El. 11:	72.6x74.0, r=1.019
A.El. 12:	72.9x74.2, r=1.019
A.El. 13:	73.2x75.0, r=1.024
A.El. 14:	74.1x75.9, r=1.024
A.El. 15:	70.8x74.0, r=1.045
A.El. 16:	70.7x74.1, r=1.047
A.El. 17:	71.5x74.5, r=1.041
A.El. 18:	73.0x74.8, r=1.025
A.El. 19:	72.6x74.8, r=1.029
A.El. 20:	73.5x75.5, r=1.027
A.El. 21:	70.0x74.2, r=1.059
A.El. 22:	70.6x73.2, r=1.037
A.El. 23:	71.9x74.0, r=1.029
A.El. 24:	72.3x74.4, r=1.029
A.El. 25:	73.6x76.2, r=1.035
A.El. 26:	74.4x76.3, r=1.026
A.El. 27:	70.7x74.6, r=1.056
A.El. 28:	71.0x73.9, r=1.042
A.El. 29:	71.1x74.6, r=1.048

Mean ellipse axis: 73.55 (std: 1.542)
Mean axis ratio: 1.03 (std: 0.012)

Median ellipse axis: 74.01

Update

Automated hole measurements

The screenshot displays the TECHTRA software interface for automated hole measurements. The main window shows a microscopic image of a gemstone surface with several holes identified and measured. The measurement results are displayed in a panel on the right.

Color (HSV) Histogram

Hole Annotation

- Channel: V
- Threshold Low: 0.0
- Threshold High: 134.237368421
- Min. Area [μm^2]: 706.0
- Smooth Rad. (px): 2.0
- Display Contours? Fit Ellipses?
- Apply

File List

- 3ksperyenty/gem_o46/gem1/raw_img
- botPG_x10.jpg
- botS_x10.jpg
- topLD_x10.jpg
- topLG_x10.jpg
- topPD_x10.jpg
- topPG_x10.jpg
- topS_x10.jpg

Measurement Results

Measures of:
C:/Janek/Eksperyenty/gem_o46/gem1/raw_img/botS_x10.jpg
on Thu Feb 14 18:07:14 2013

Per-hole measurements:

Label	Center (x, y) [μm]	Size (x, y) [μm]	Angle [$^\circ$]	r
se 23	(232.7, 234.9)	78.0 x 78.0	9.9	
AutoEllipse 22	(377.9, 244.2)	76.0 x 78.3	-25.5	
AutoEllipse 21	(522.9, 253.3)	76.6 x 78.4	-23.6	
AutoEllipse 17	(297.7, 365.1)	76.3 x 77.7	-27.7	
AutoEllipse 16	(442.6, 374.1)	75.9 x 77.5	-18.3	
AutoEllipse 15	(587.5, 382.8)	76.1 x 77.7	-34.9	
l1	(5, 485.8)	77.4 x 77.4		
AutoEllipse 10	(362.5, 494.5)	76.3 x 78.3	-28.2	
AutoEllipse 9	(507.5, 503.6)	76.3 x 77.7	-21.1	
AutoEllipse 8	(652.2, ...)	76.2 x 7...	-14.1	

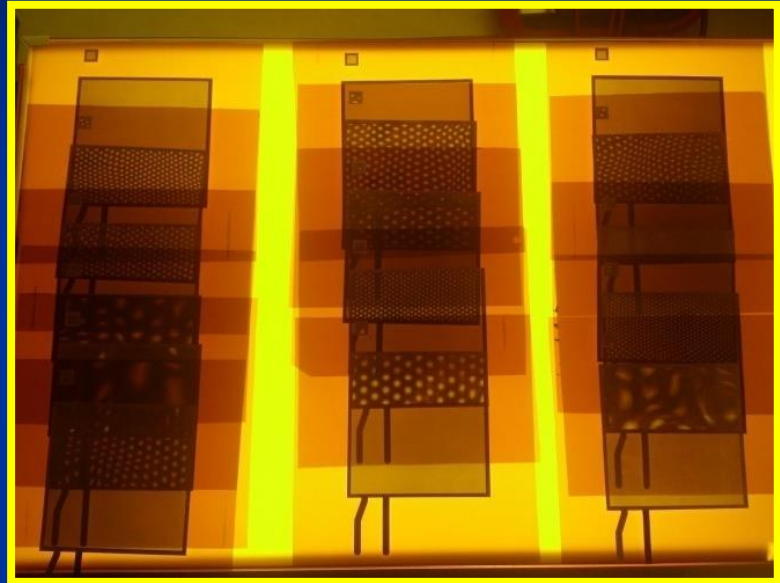
Update

Independent AIMS:

1. „Dedicated line for big GEMs become operational by the end of March 2013” → June 2013
2. Implementing single mask technique for:
 - production of 10x10cm GEMs with old machinery set
 - production of 20x20cm GEMs with old and new machinery set
3. Automatization of electrical and optical testing position.

Our Core GEM Team

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