Indian Industrial Outreach for GEM Foil Development

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on behalf of India CMS GEM collaboration

Indian Industrial Outreach

(first emails sent in June 2013)

Thanks !!

to the initiative taken by Dr. A. K. Mohanty
&
support provided by Dr. Archana Sharma

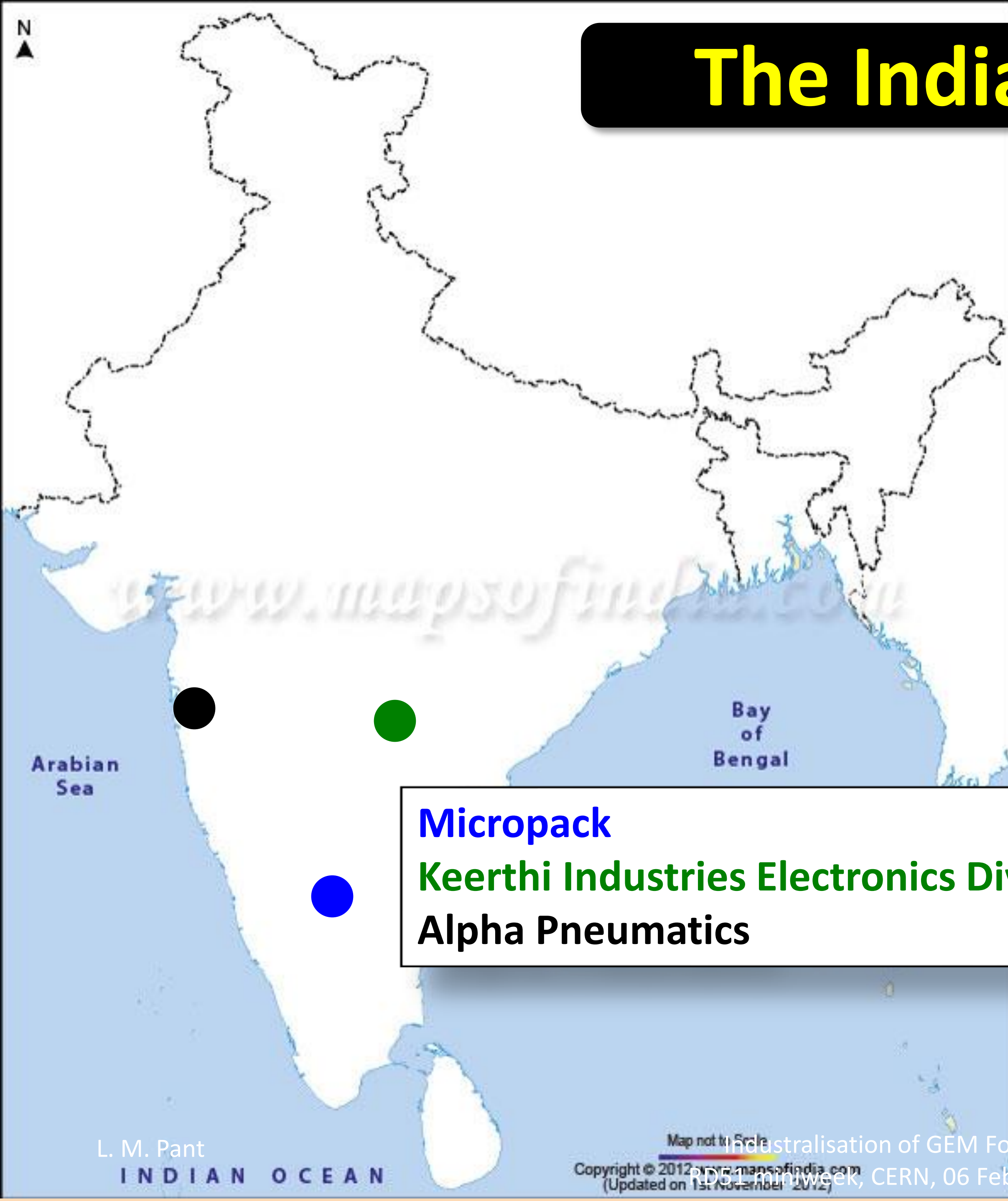
Transfer of Technology for GEM foil development to Indian Industries

Keerthi Industries Ltd. - Electronics Division,-KIED, Hyderabad :
Visit by BARC on 02 Aug.
: Visited CERN in October end for ToT / Licensing
: Needs artwork from CERN for Cu etching for 10 cm x 10 cm foils

Micropack, Bangalore :
Visit by BARC on 07 Aug.
: Visited CERN in November 2013 for ToT / Licensing
: Started with pilot production on Cu and polymide etching

Alpha Pneumatics, Mumbai :
: Plans to visit CERN in 2014 for ToT
: To start with Cu and dry polymide etching has been initiated

The Indian industries



Micropack	Bangalore
Keerthi Industries Electronics Division, KIED	Hyderabad
Alpha Pneumatics	Mumbai

Transfer of Technology for GEM foil development to Indian Industries

Recipie

Tools and Equipments

Quality Control and Quality Assurance

Fine tuning of the existing infrastructure

Electronics Division

Printed Circuit Boards

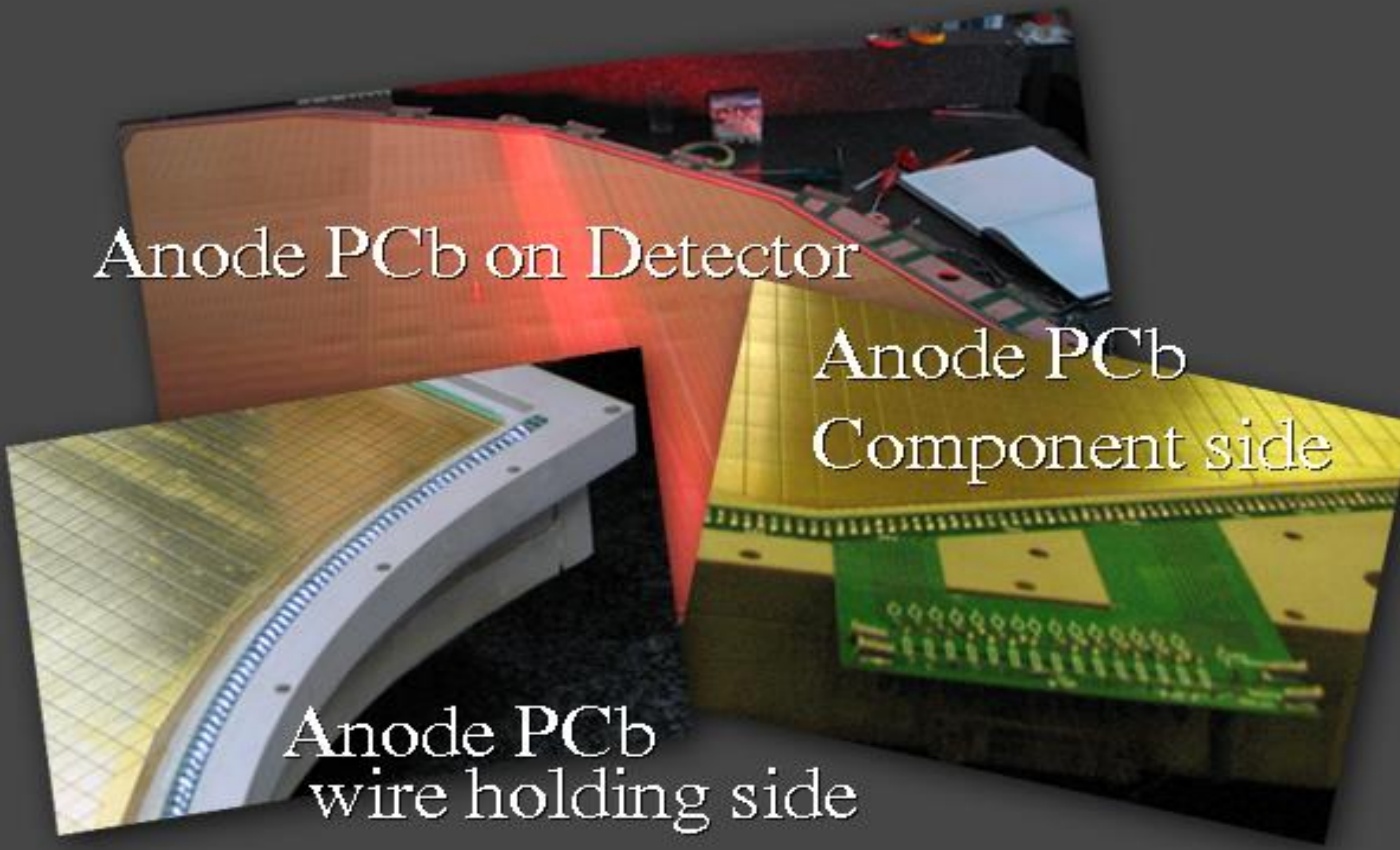
(Flexible, Rigid & Rigid flex)

Hyderabad, AP

Slides from KIED

Slides from KIED

PCBs made by KIED for ALICE, CERN

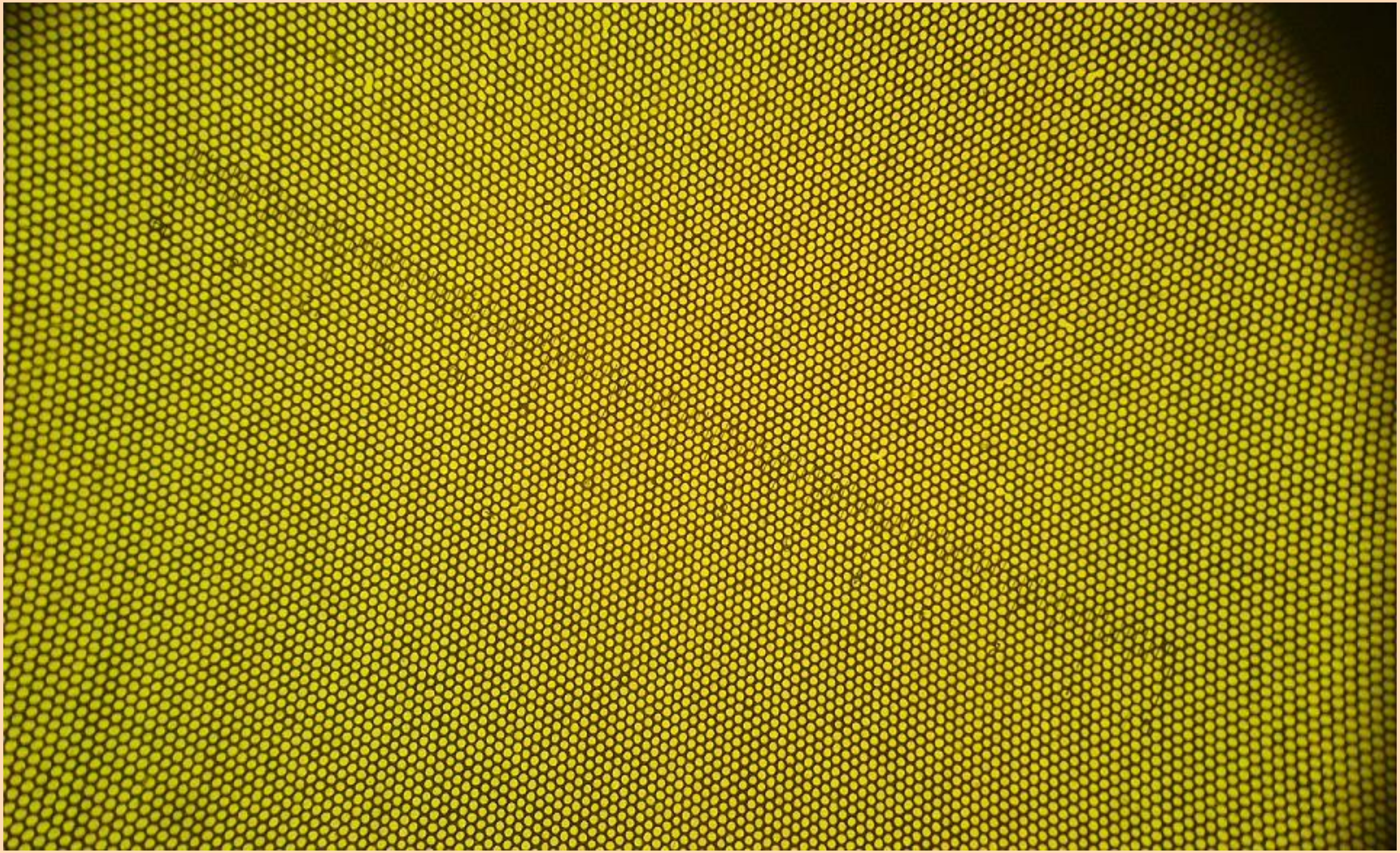


Slides from KIED

CMS, CERN : GEM Foil with KIED

Slides from KIED

A Pattern of Cu etching on GEM Foil : First trial by KIED



Working with India CMS Group / CERN

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- **Has been associated with CERN projects through Saha Institute of Nuclear Physics since 2011.**

- **Thin Polyimide GEM foil technology introduced to Micropack by India – CMS team in Aug 2013**
  - **- Visit by India CMS team to Micropack to introduce the technology**
  - **- Requirements of GEM upgrade project for CMS briefed**
  - **- Scope and need for development of GEM Foil technology in India**
  - **- Process Brief**
  - **- Feasibility discussions**

Slides from Micropack

Processing Trials

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Basic feasibility trials conducted at Micropack as per the process brief provided by BARC

Encouraging results with polyimide etching / copper electro etching

Decision taken to pursue the technology for the development of GEM foils

Visit to CERN, Geneva planned

Slides from Micropack

www.micro-pack.com

Discussions at CERN

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- Visited CERN , Geneva on 15th Nov 2013
- Discussions with Dr. Rui De Oliveira

  Dr. Andrey Marinov

  Dr. Tim Tsarfati, Technology Transfer Officer

- Draft TOT agreement shared by Dr. Tsarfati
- TOT agreement terms agreed by Micropack
- 2 year road map as per the TOT finalised in December 13.

Slides from Micropack

www.micro-pack.com

MICROPACK ROADMAP

S.No.	Item	1Q		2Q			3Q			4Q			1Q			2Q			3Q			4Q		
		2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
1	**License Agreement**																							
2	**100 x 100 Fabrication and QC Validation**																							
	- Rebuild equipments/utility for GEM Foil																							
	- Prepare raw materials(FCCL, mixed chemicals)																							
	- develop the ***prototype***																							
	- QC validate the prototype @COMPANY																							
	- QC validate the prototype @COMPANY																							
3	**100 x 100 Routine and standard production , 300 x 300 R&D**																							
	- ***100 x 100 routine*** & standard production																							
	- develop the ***prototype of 300 x 300***																							
	- QC validate the prototype @COMPANY/CERN																							
4	**300 x 300 Routine and standard production , 500 x 500 R&D**																							
	- ***300 x 300 routine*** & standard production																							
	- develop the ***prototype of 500 x 500***																							
	- QC validate the prototype @COMPANY/CERN																							

Slides from Micropack

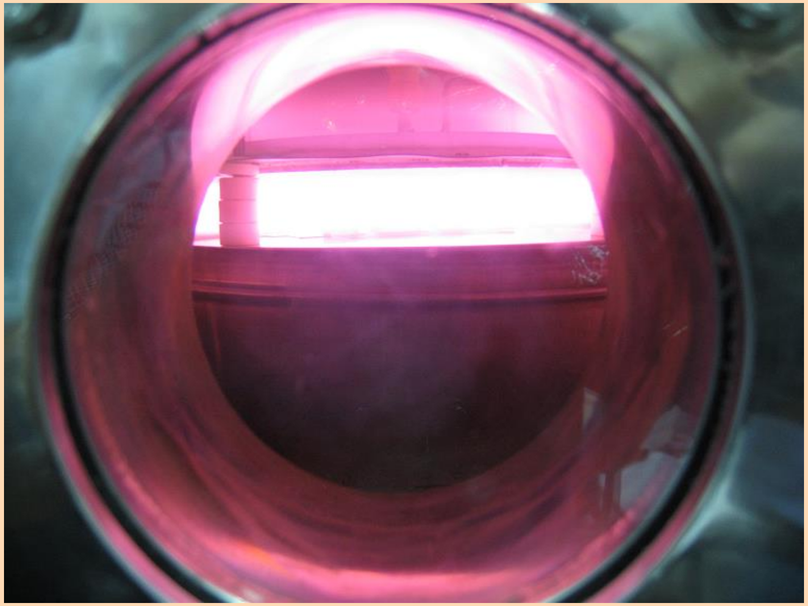
Plasma Etching : advantages over conventional wet chemical process

- Gas Phase reaction - clean and precise.
- It is possible to etch copper and Kapton in succession.
- Photo-resist mask can be removed by Ashing (O2 plasma)
- Change of etchants through switching of MFC channels
- Etch process can be programmed to etch many layers one after other .
- End point detection by OES (optical emission spectroscopy)
- Excellent control over Differential etch rate between copper and KAPTON
- DC bias : controlled ion energy for directional etching
- Anisotropy : Vertically profiled etched grooves with Large aspect ratio can be achieved possible.
- Very low undercutting

Slides from Alpha Pneumatics

Plasma etching at Mumbai factory

RF Plasma at 1 torr



WITH OXYGEN

WITH R134a FREON

Shower-head electrode

View window of toughened glass to view RF plasma

Also used for Langmuir Probe /OES measurements

Shower-head electrode has nearly 500 holes of 0.3 mm dia. to distribute gas mixture uniformly over entire 270 mm X 270 mm area.
This plate is hard anodized on front surface and also serves as RF powered electrode

Kapton Etching parameters

- Gas Pressure : 1.10 torr
- For Polyamide

  a) R134a : 5 SCCM (20%)

  b) O2 :20 SCCM (80%)

  Achieved etch rate : 0.5 micron/Min

For Copper

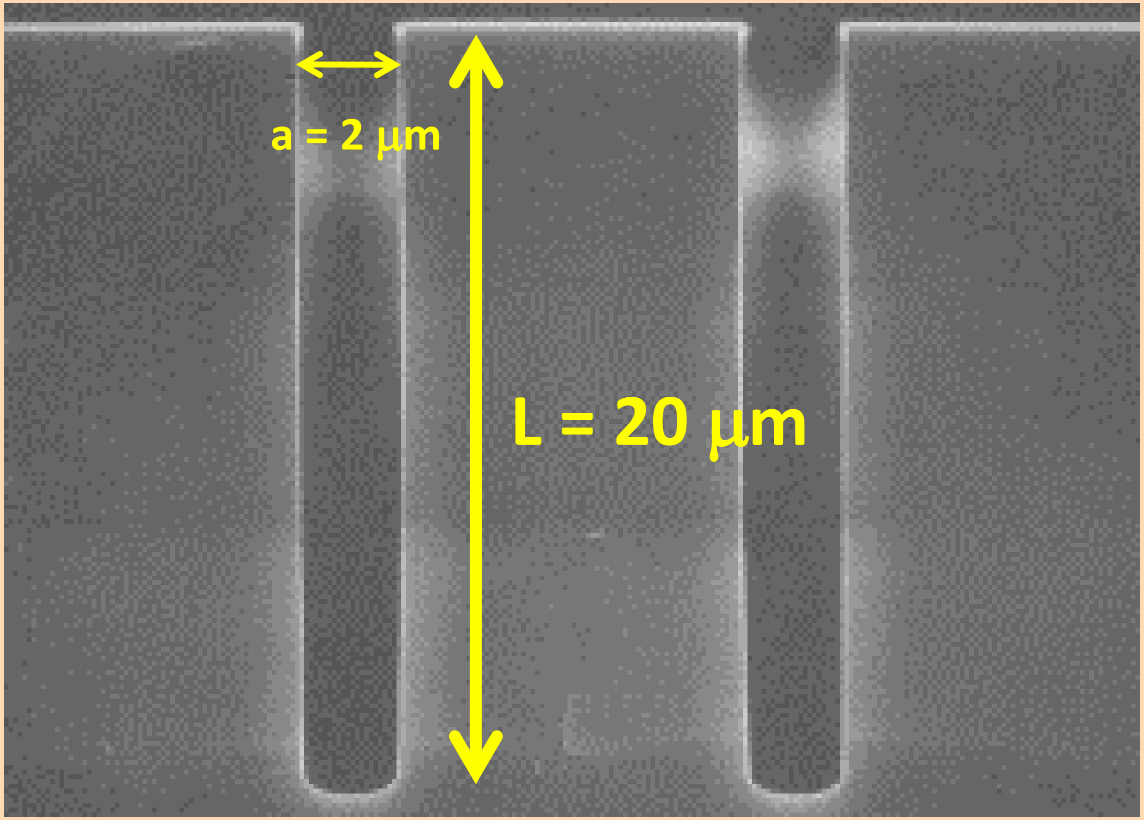
  a) R134a : 25 SCCM

  b) O2 : 2.5 SCCM

  Achieved etch rate : 0.1 micron /Min

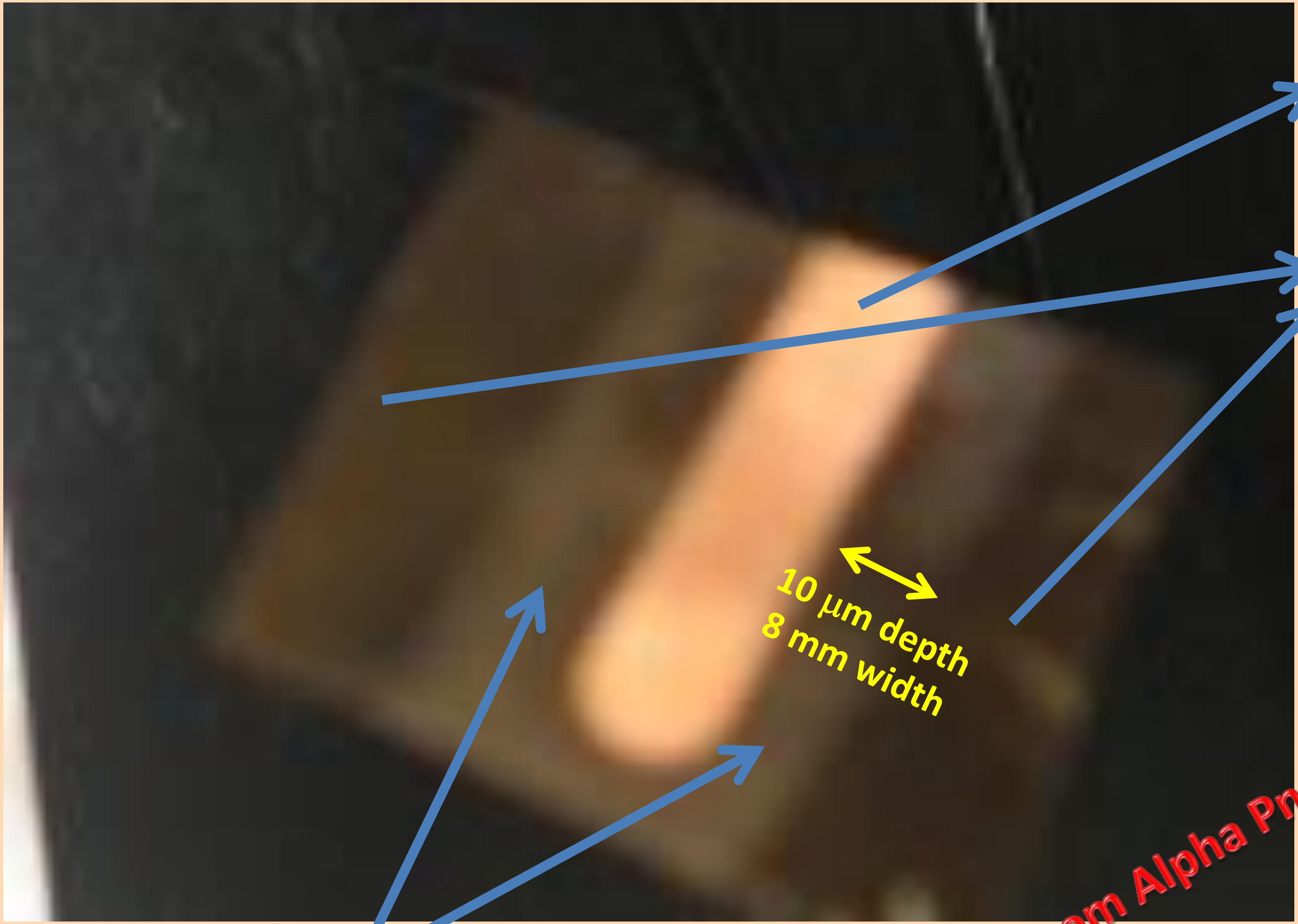
- RF Power Density : 1.03 Watt/Sq cm.
- Substrate Temp : 25C (Start), 35C (End)
- Duration : 10 .0 min

SEM photograph of plasma etched silicon grooves with large aspect (L / a) ratio



Slides from Alpha Pneumatics

Etching of Kapton Foil



Copper finger

Covered strips

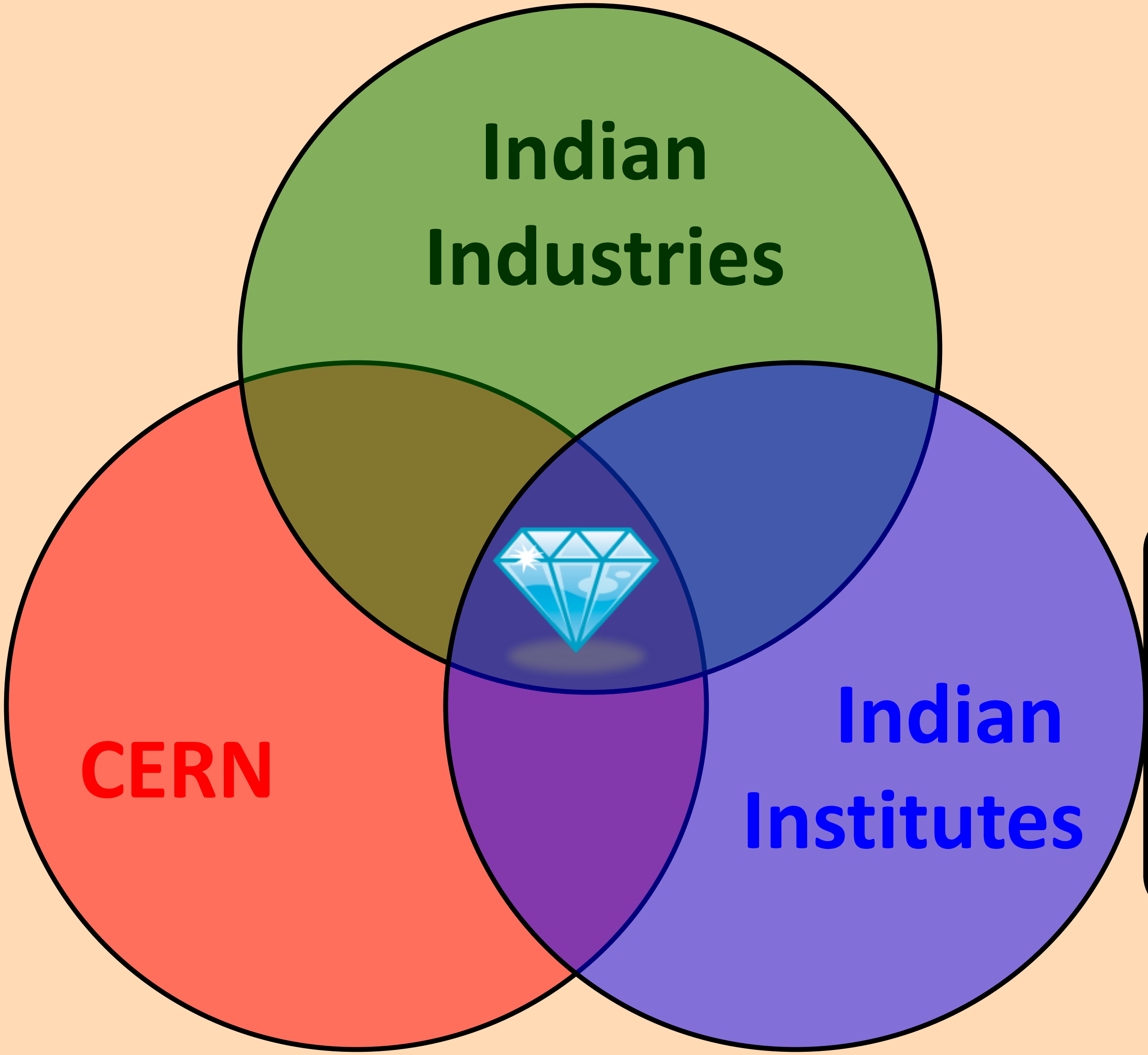
Etched Steps

Slides from Alpha Pneumatics

Summary and Outlook - 1

- ToT exists between Micropack and CERN
- ToT exists between KIED and CERN
- Alpha Pneumatics plans to visit CERN in Summer 2014

Summary and Outlook – 2 : A GEM Collaboration



BARC
DU
NISER
PU
SINP