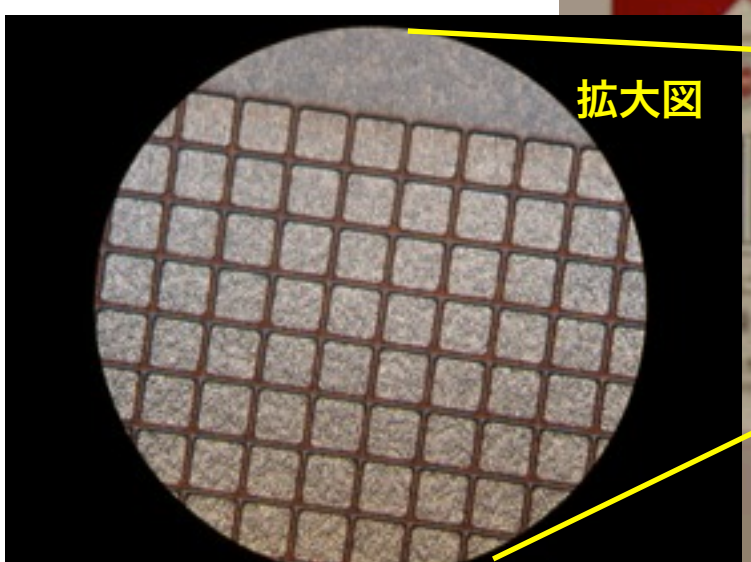
New Gate device R&D

history
what is the point
toward new device



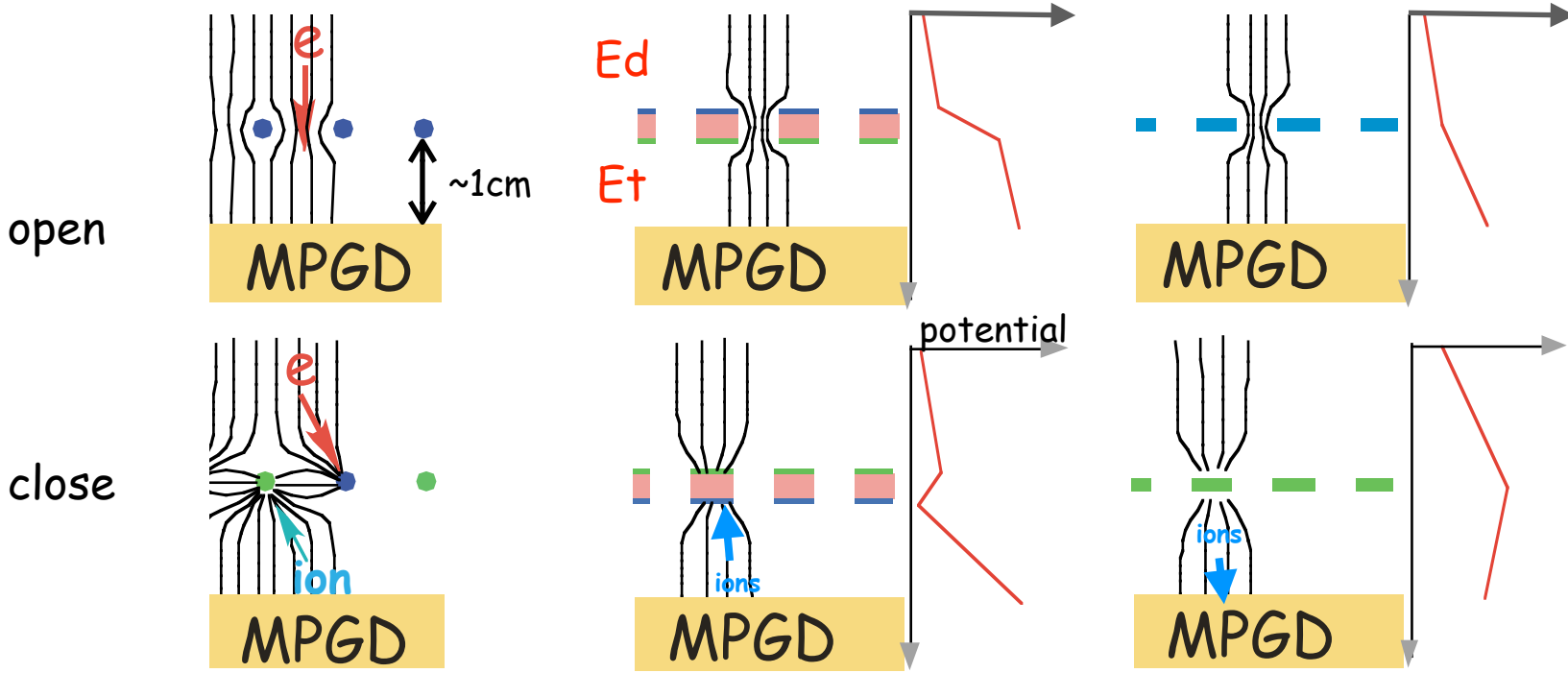
Why GEM

You may suggest us
to use wires for this.

But....

Gate: wire GEM micromesh

3 candidates



F.Sauli, L.Ropelewski,P.Everaerts NIM A560(2006)269-277

F.Sauli show us a new usage of GEM as Gate device
with a certain gas mixture
and a possibility to improve Elec. trans.
modifying GEM struct.

High elec. transmission @ low VGEM

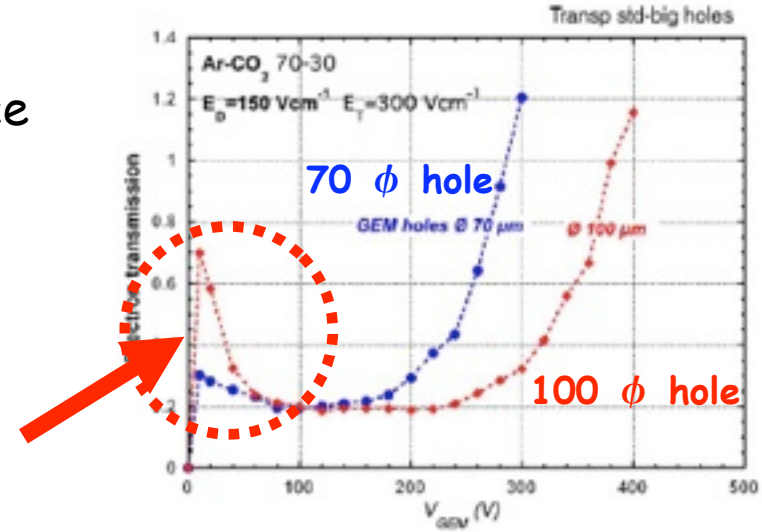


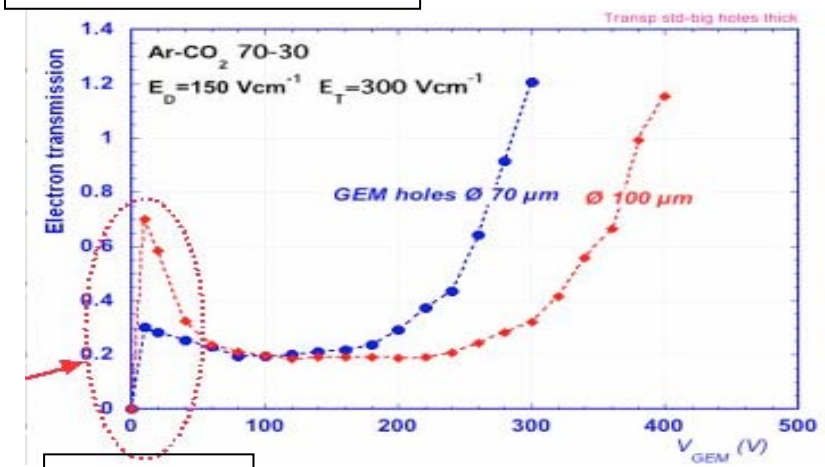
Fig. 6. Comparison of electron transmission for two GEM foils: standard

reproduce Sauli's exp. data by simulation

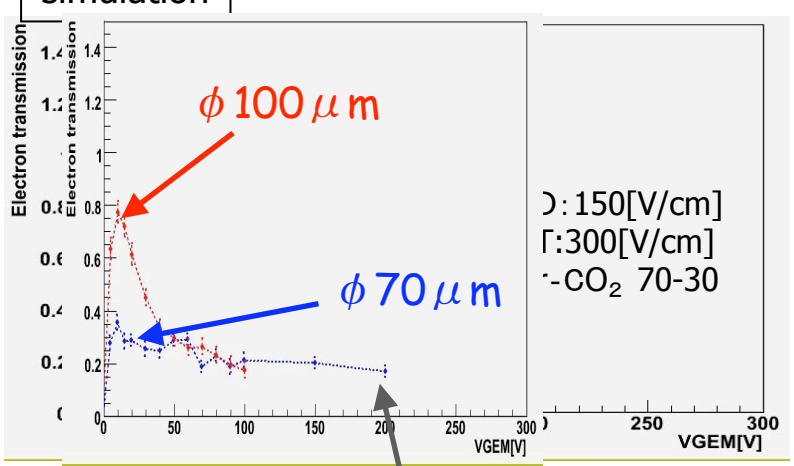
model/param. tune of
Maxwell3D/Garfield

Electron transmission
Hole size dep.

Measurement by Sauli

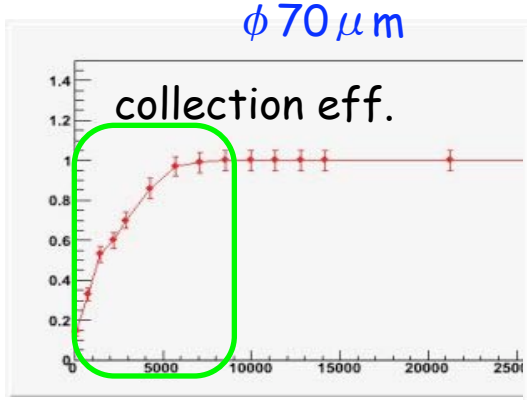


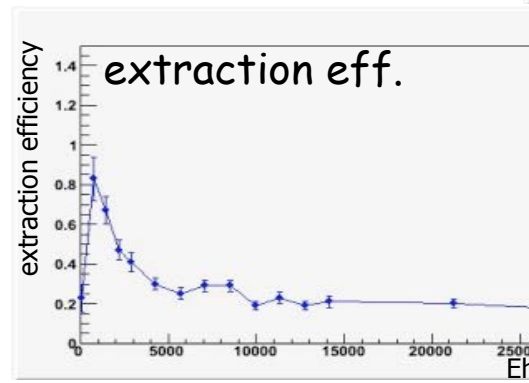
simulation

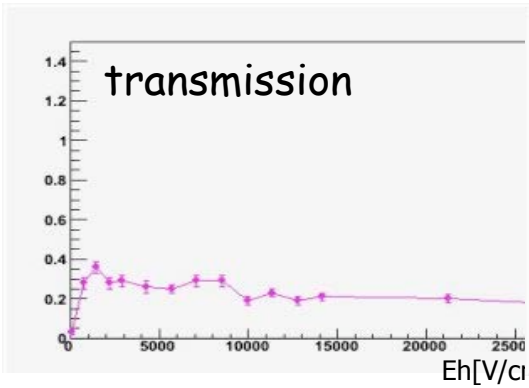


Gas gain is not included

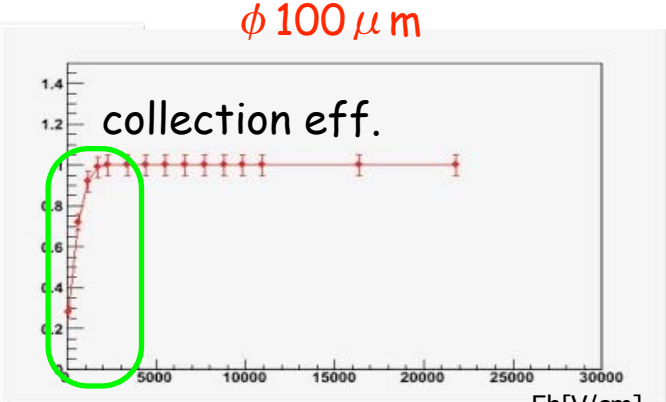
ϕ 70 μm

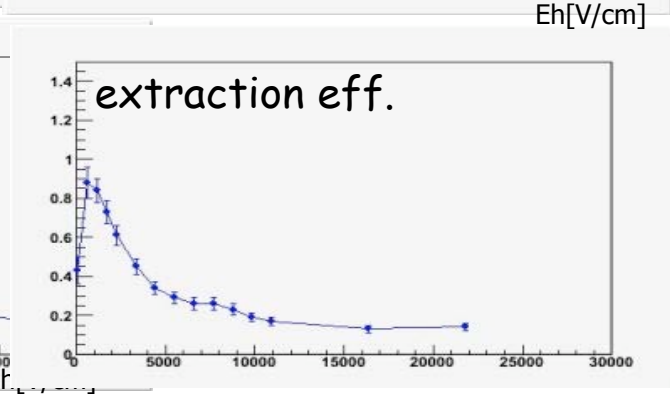


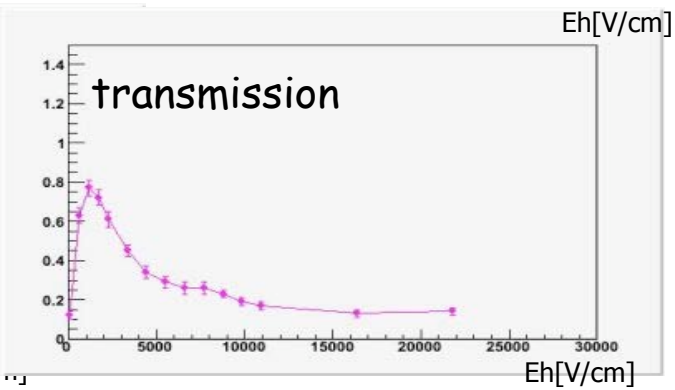




ϕ 100 μm





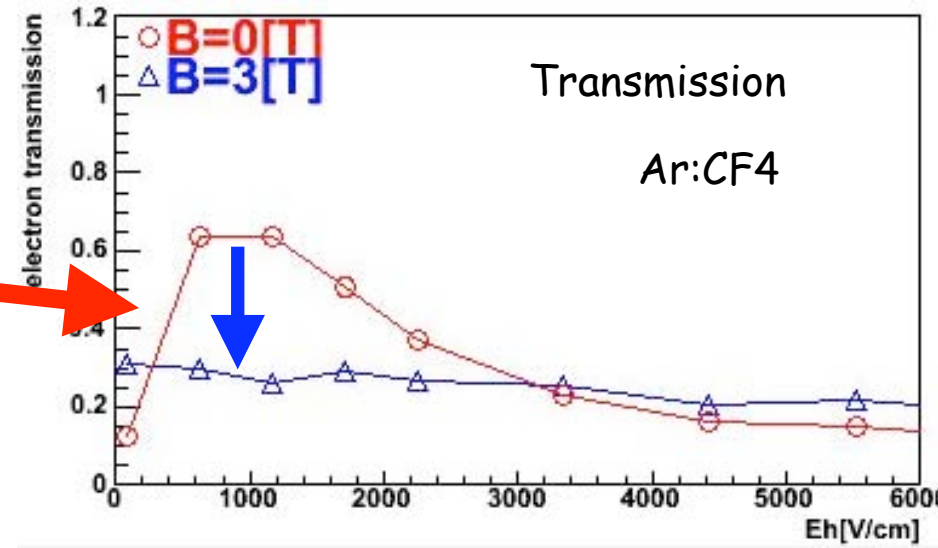


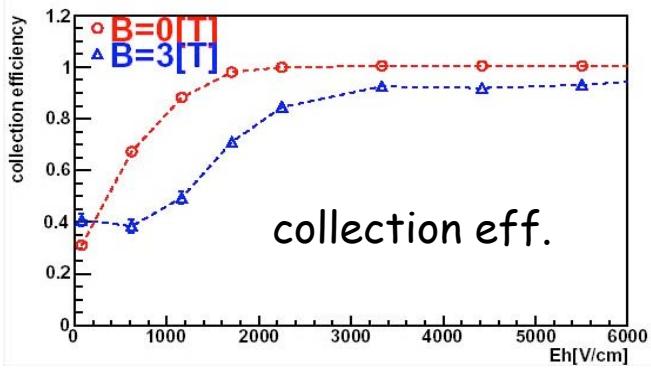
Collection eff. improve transmission
due to large aperture

Transmission under B field

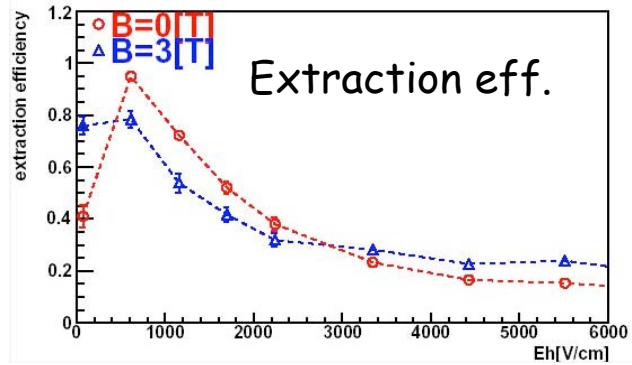
B filed change the behavior of transmission
like this

due to;



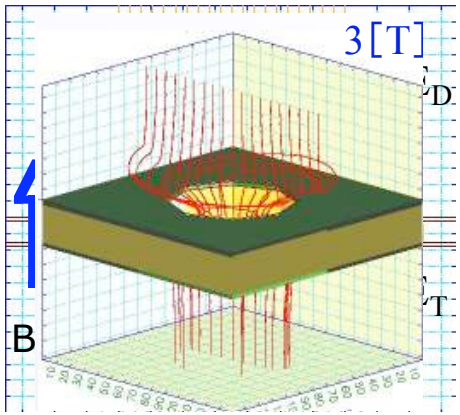


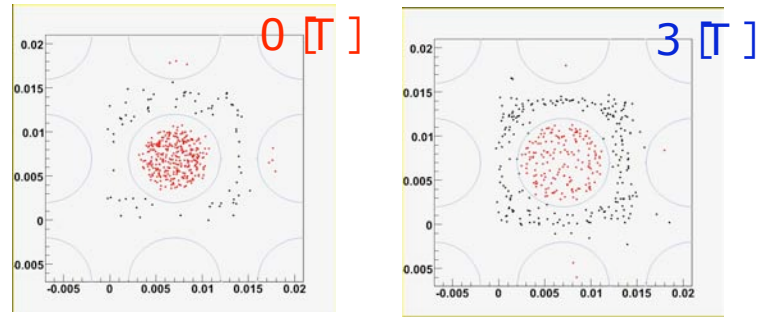
electron move along B field
due to Lorentz angle
rather than E field



Extraction will be recovered
due to Lorentz angle

But
electron position@hole entrance
is spread over entire hole
-> diffusion loss in hole
(follow return line)





We cannot accept 30% transmission !

comparison to simulation

Good agreement @ B = 1 T

behavior

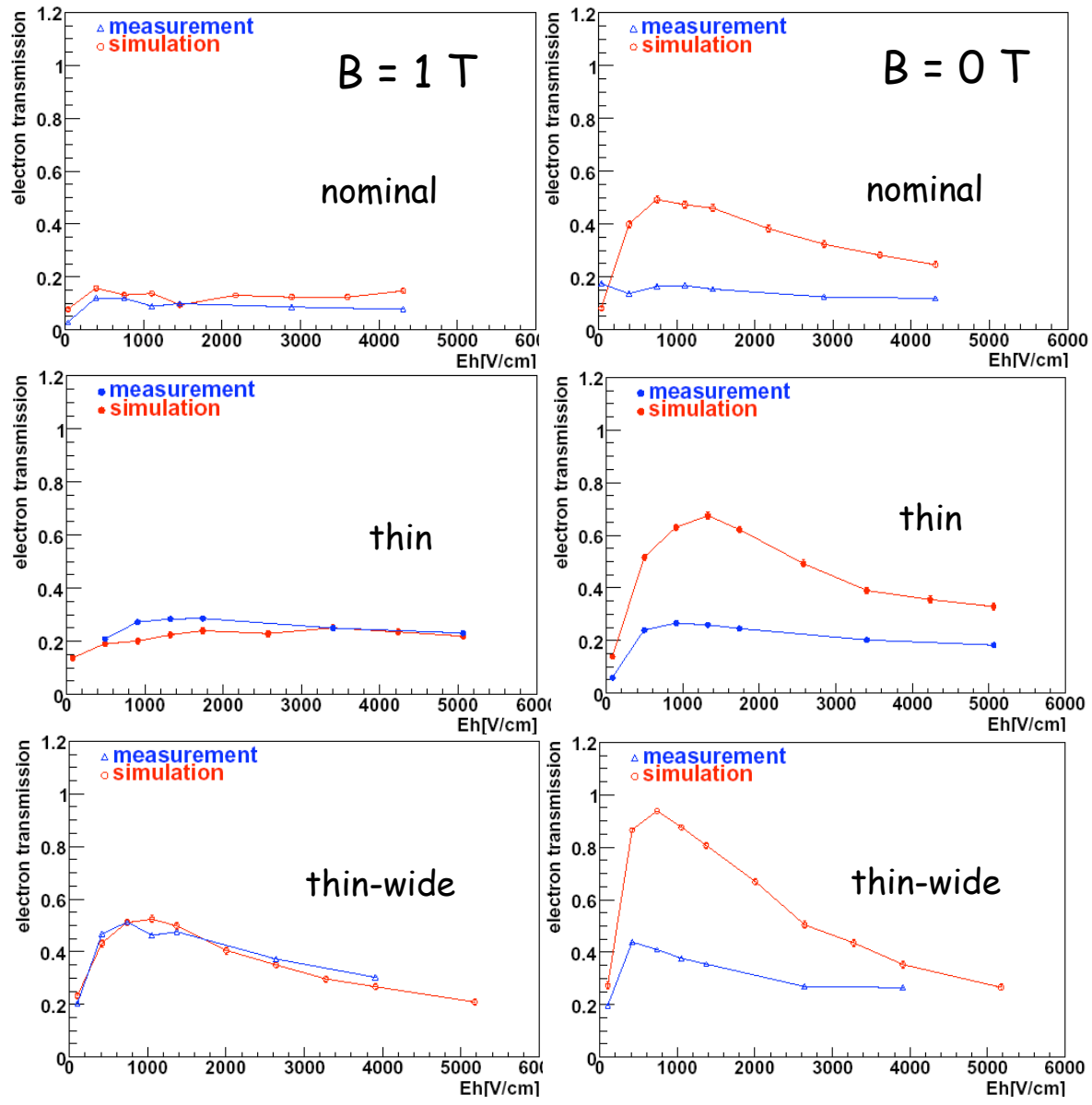
absolute value

quite different for B = 0 T

Agreement @1T is too good

just to be an accidental

How can we understand these ?



artificial step size reduce the reliability of garfield result
for different gas mixture
-> this was fixed by new "microscopic tracking"
but another parameter "e_min/max" exist

and mag. field is not implemented in garfield w/
microscopic tracking.

We have to move to Garfield++ w/ ANSYS

From the simulation study
we realized
transmission of Gate largely depend on aperture
in higher B field !!

Making hole radius large is the only solution for this.

But PCB (GEM) technology cannot do this.
controlling passive etching is not easy
at level of less than 10um accuracy

Photolithography can solve this

Gate production using photolithography

using positive tone photoresist

may solve mask alignment difficulty -> large size

exist ??

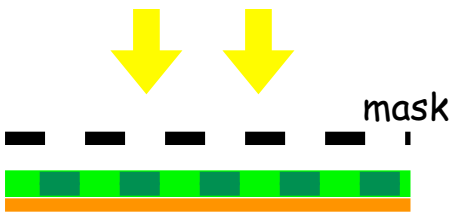
mechanical strength ??

not known yet unless material is chosen

case of negative tone such as SU8

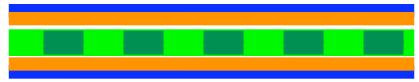
1) lamination

2) Exposure

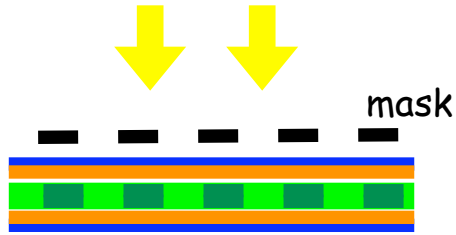


3) lamination or spattering

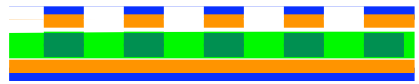
4) coat by photorsist



5) Exposure(metal pattern)



6) Development(metal pattern)



7) Development(resist pattern)

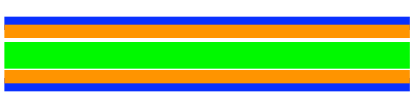
8) Development(metal pattern)

case of positive tone

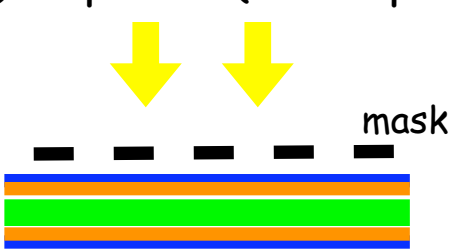
1) lamination

2) lamination or spattering

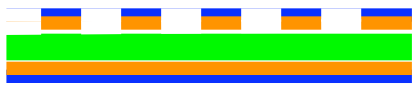
3) coat by photorsist



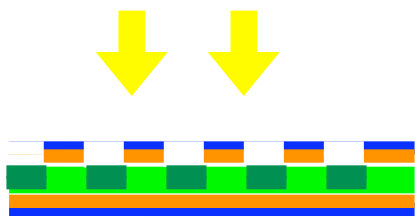
4) Exposure(metal pattern)



5) Development(metal pattern)



6) Exposure(metal pattern)



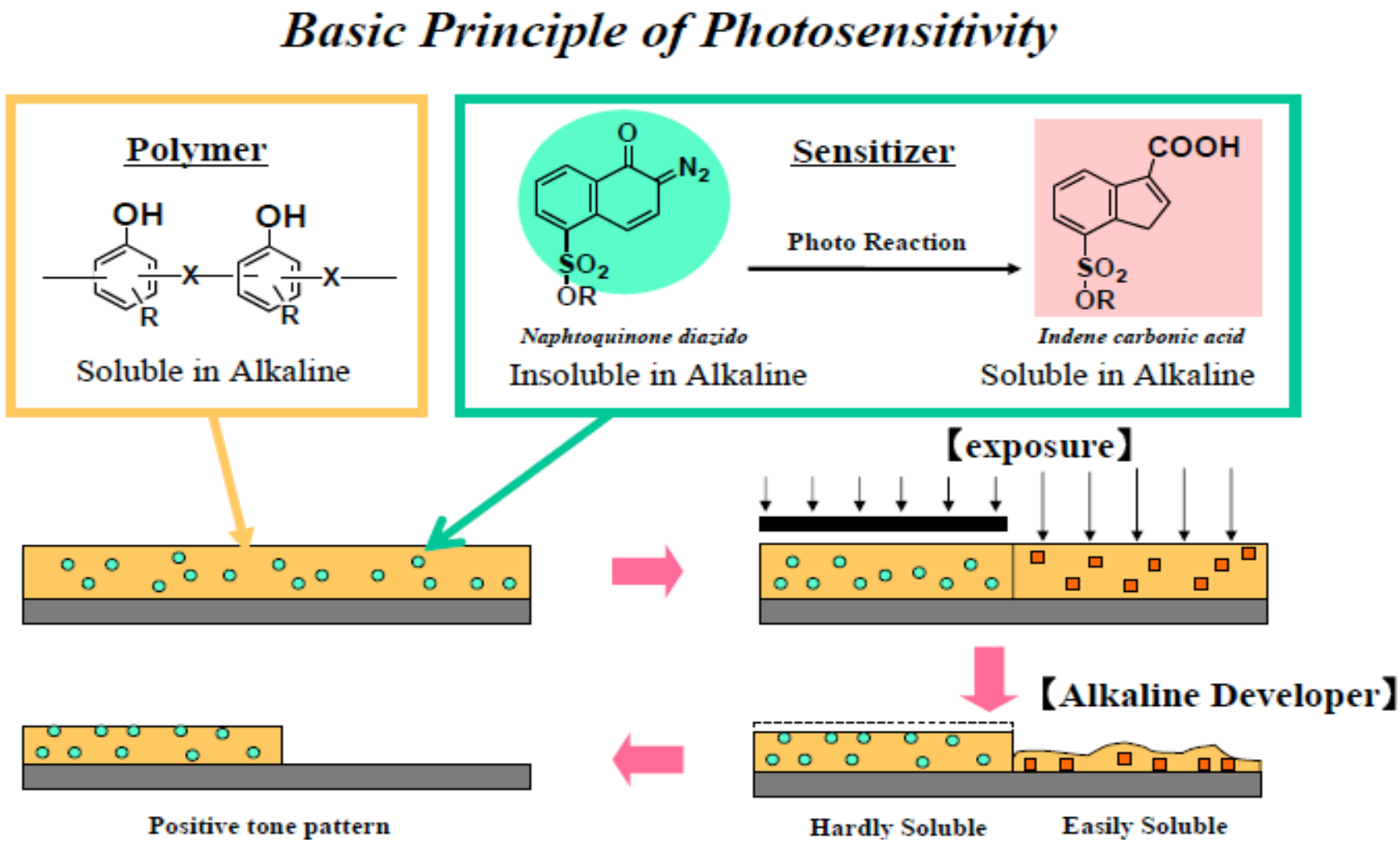
7) Development(resist pattern)

8) Development(metal pattern)

Photonease(Toray) commercial positive photoresist

like polyimide

not dry sheet ! spin-coat



We could not control the way it should be

N2 vapor produce bubble in resist (due to thickness ??)
Photoresist became not like polyimide
no flexibility, very fragile

too hard to handle by beginner

Another company pay attention to produce new photoresist based on polyimide

polymer -> oligomer

add photoresistive material

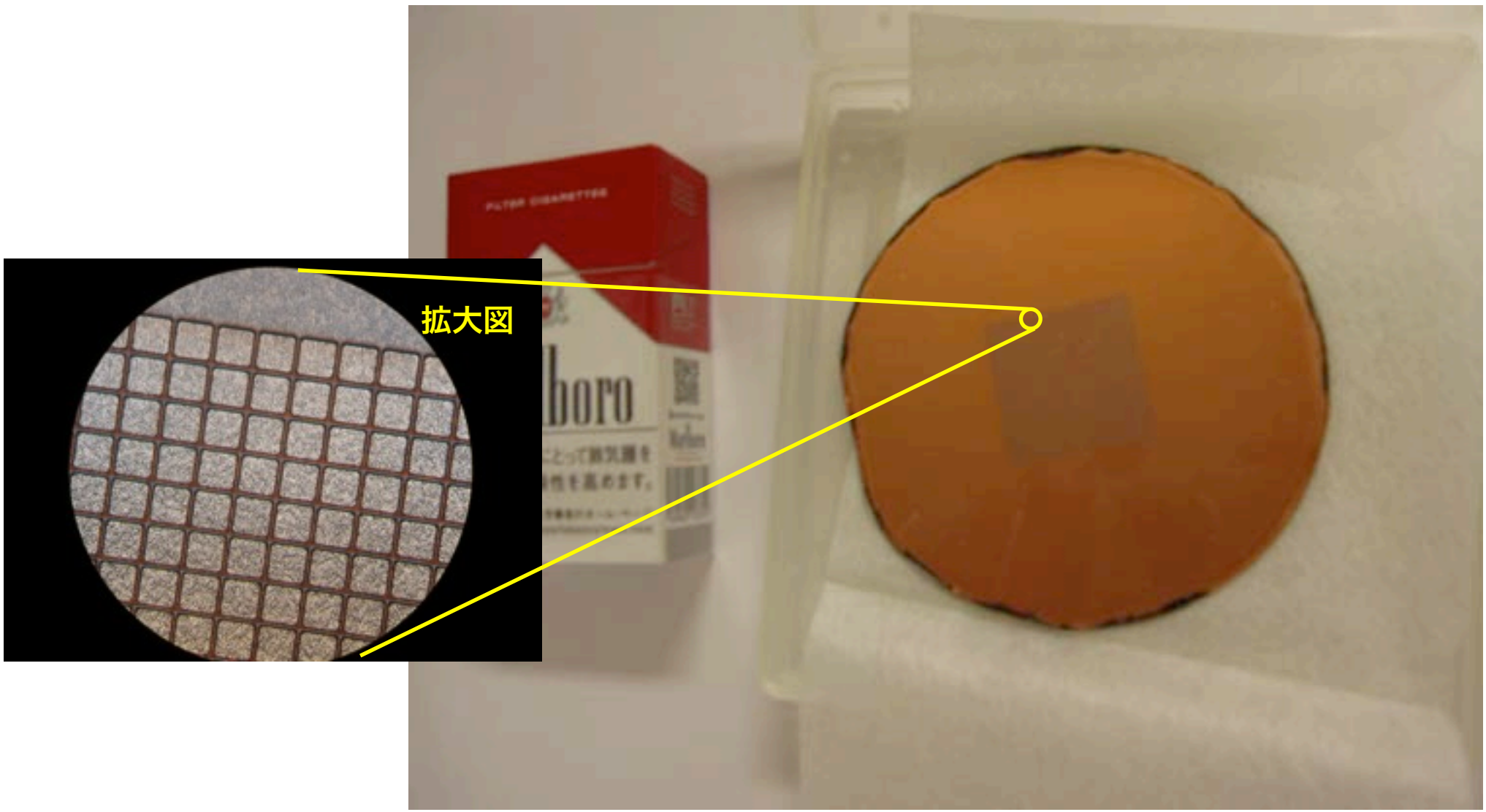
photo absorption -> hard to expose down to bottom

uniformity of photoresist .....

some more study is necessary

first trial

made on 4 inch glass plate
Cu layer + new polyimide resist



long way to Gate ??

gate device is not produced yet even for 3x3cm
material development is necessary

even if it is fixed
3x3cm -> 30x30cm is another story.