Development and evaluation of EUV mask substrate

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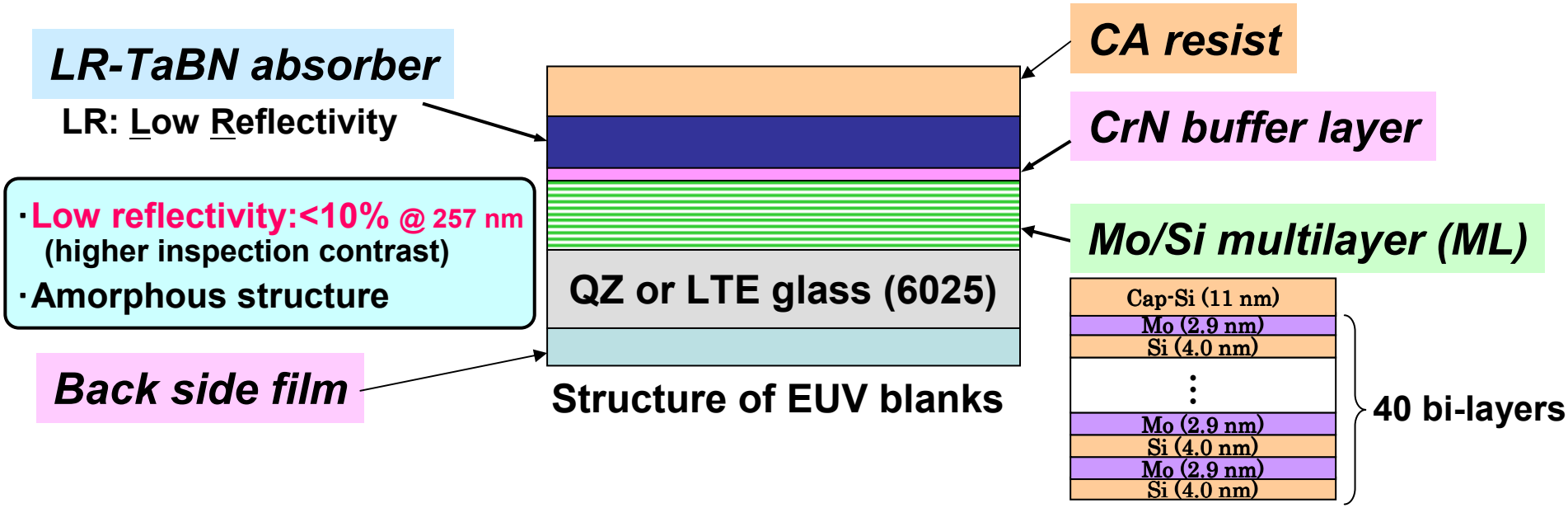
HOYA EUV blanks



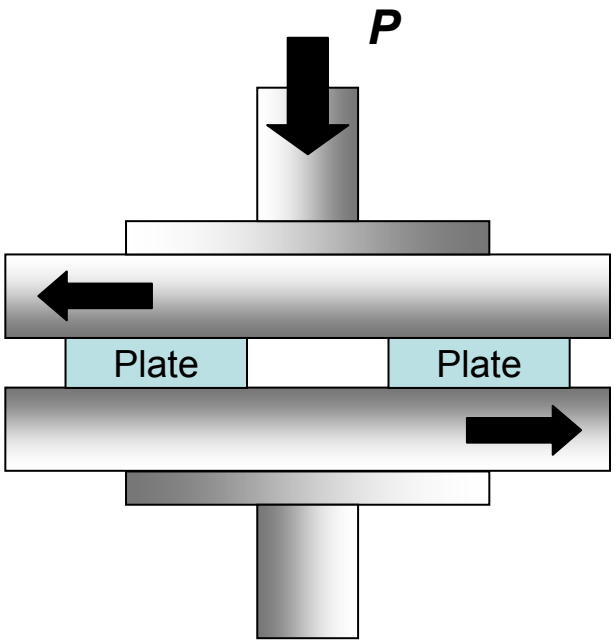
Structure of EUV blanks

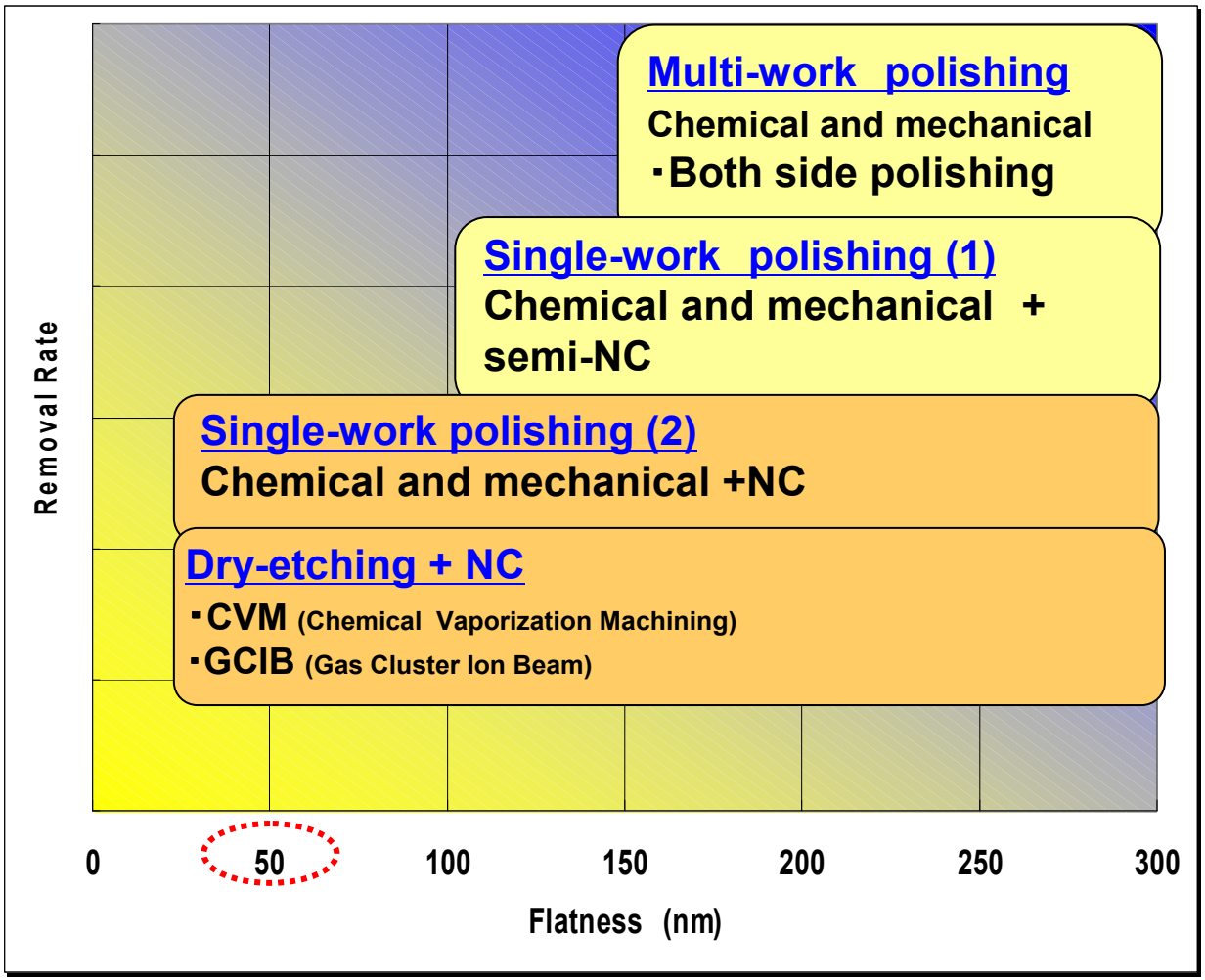
Polishing strategy for EUV substrates

Muli-work polishing

with high productivity

for photomask substrates

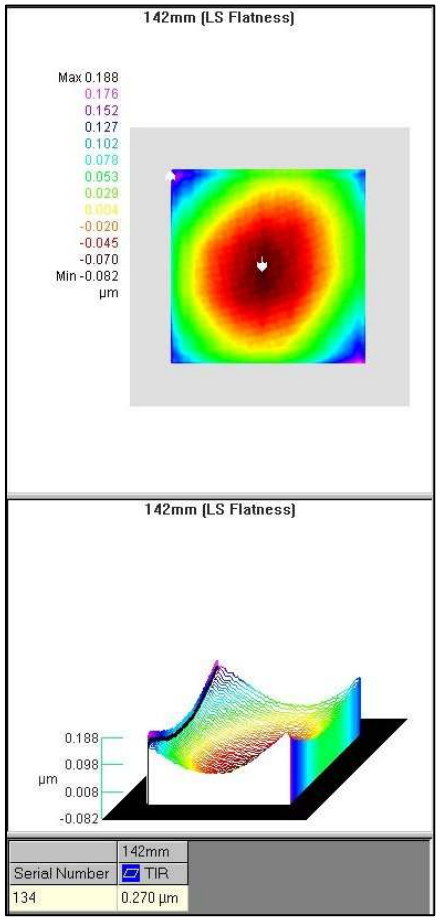




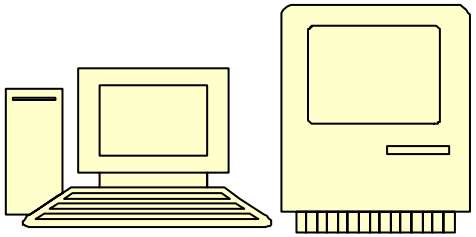
Local polishing technique is needed for attaining 50 nm flatness

Local polishing process

Initial plate

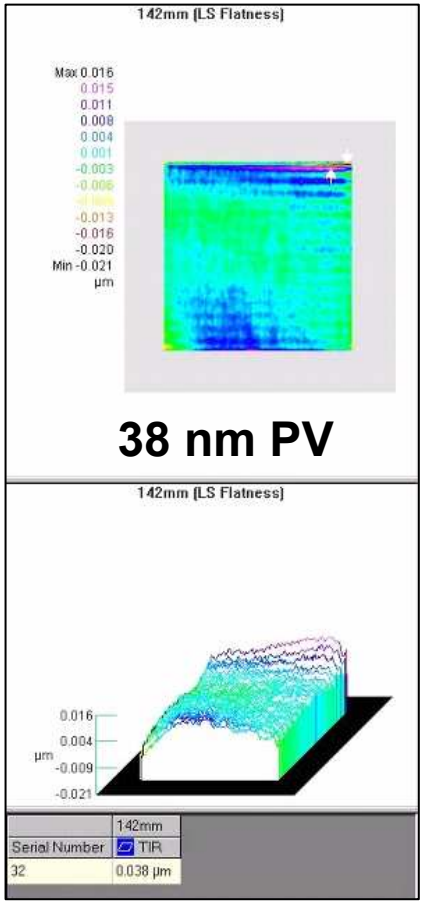


Simulation based on actual flatness



Local polishing using numerical control (NC)

After polishing



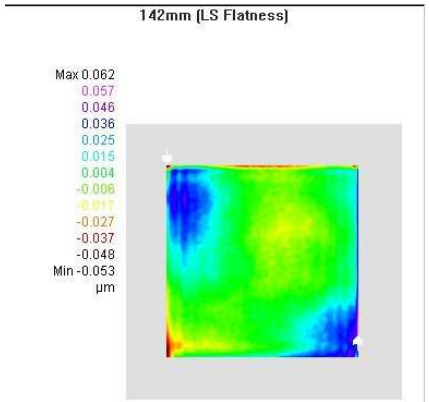
38 nm PV

- **Possible to obtain flatness of <100 nm, but generates rough surface and defect increase**

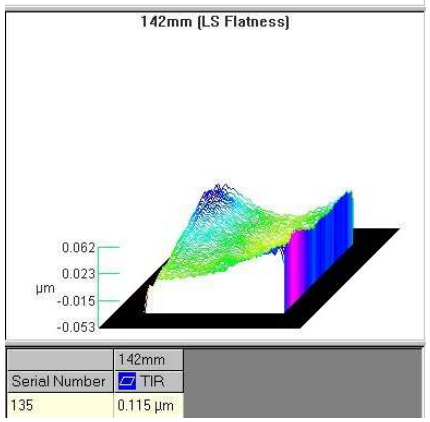
Critical Challenge is to attain 50 nm flatness, smooth surface and low defects

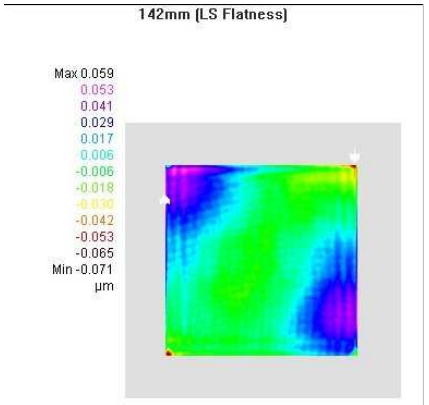
Flatness improvement on QZ

Flatness in 142 mm sq.

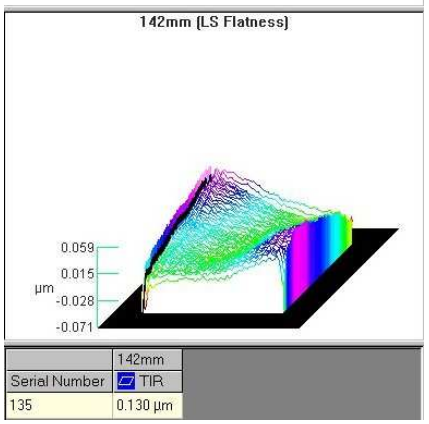


<Front side: **115nmPV**>

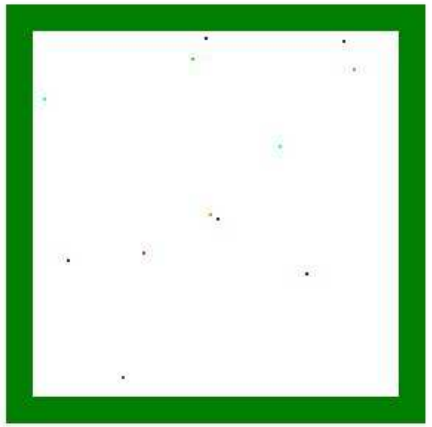


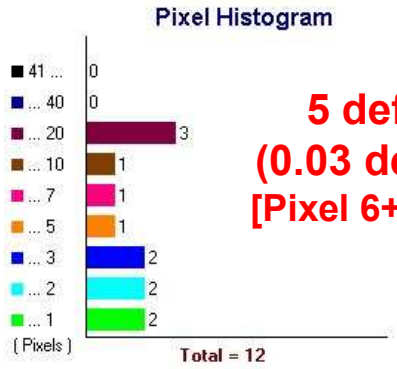


<Back side: **130nmPV**>



Defect @M1350





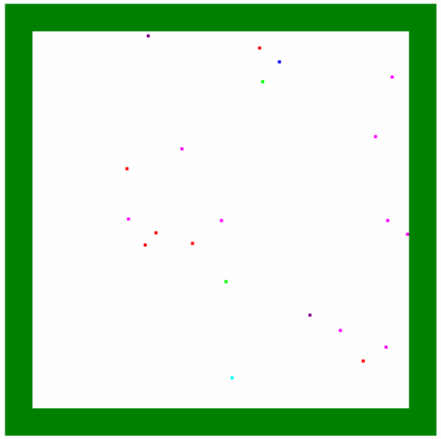
5 defects
(0.03 def/cm²)
[Pixel 6+@60nm]

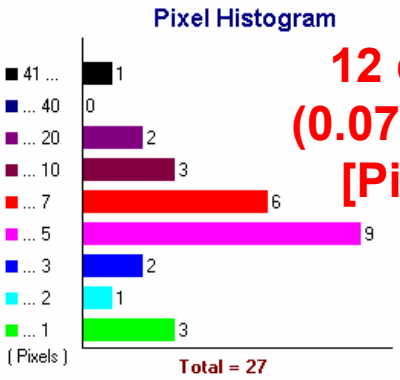
- **Achieved QZ substrate with high flatness of 115nm /130 nm and with low defects**

LTEM substrate defect quality

Properties	Unit	LTE glass ULE™ (Corning)	Quartz	SEMI spec.
Composition		SiO_2 doped with TiO_2	SiO_2	
Structure		Non-crystalline	Non-crystalline	
Coefficient of thermal expansion	ppb/℃	<±10 [<±5]	500	Class A:±5 Class B:±10 Class C:±20 Class D:±30
Density	g/cm^3	2.21	2.21	2.1 - 2.6
Elastic modulus	GPa	67.6	73.1	65 - 91
Refractive index		1.48	1.46	1.4 - 1.6

Defects @M1350 on ULE substrate





12 defects (0.07 def/cm²) [Pixel 6+]