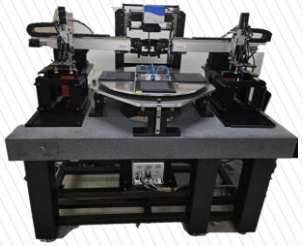
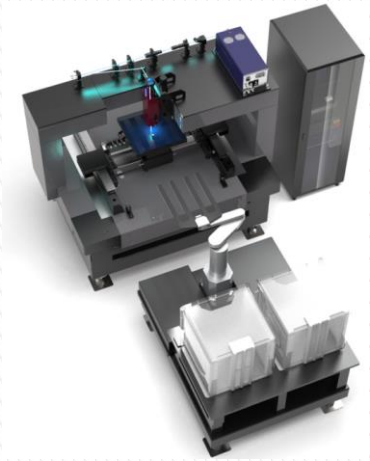
u-Lab.

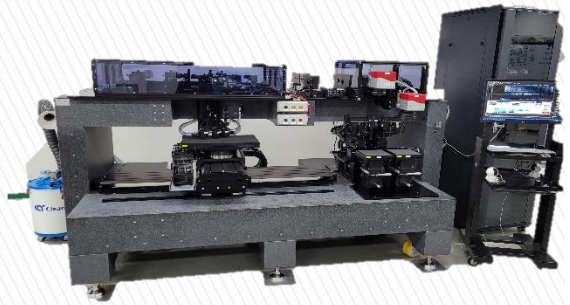
Laser Patterning Machine based on Gantry Sys.



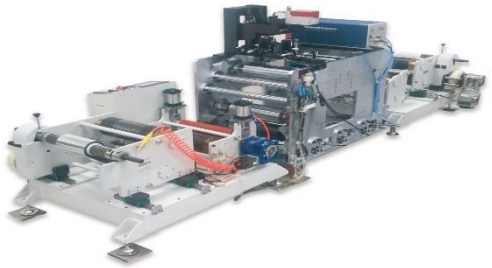
Laser scriber with wafer rotary unit



Maskless Laser Lithography



u-Fab.



Laser Patterning Machine based on R2R

Established in 1999

(주)코썸사이언스

A.I. Deep Learning

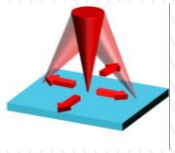
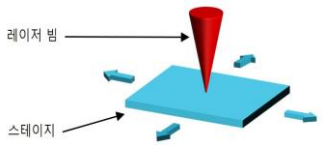
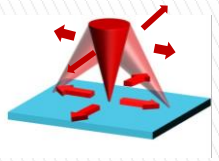
레이저 Patterning 장비 소개

KOS Innovative Laser Technology

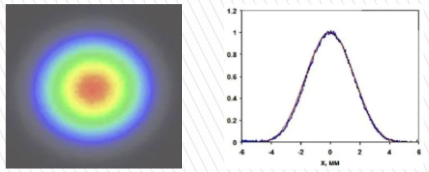
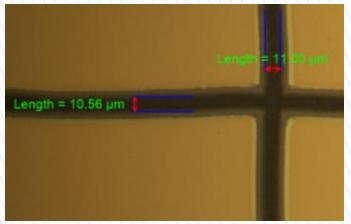
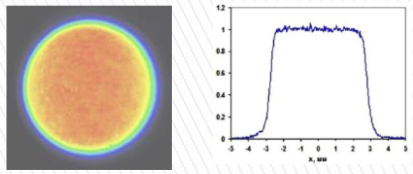
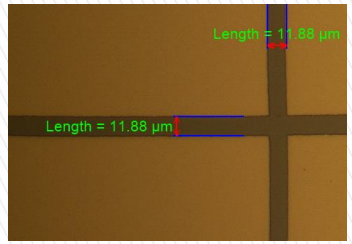
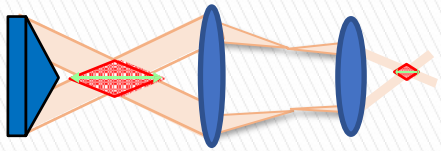
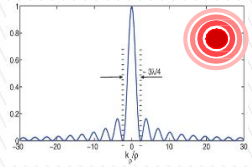
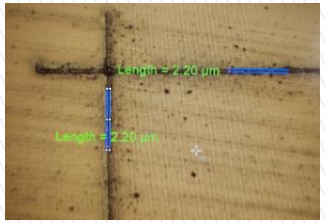
KORTherm Science. Co., Ltd

[연구소] 인천광역시 서구 로봇랜드로 155-11 로봇타워 1001호
[본사] 인천광역시 부평구 청천동 425 우림라이온스밸리 C동 1203B호
TEL. 032)623-6320~4 FAX. 032)623-6325 e-mail : kos@kortherm.co.kr

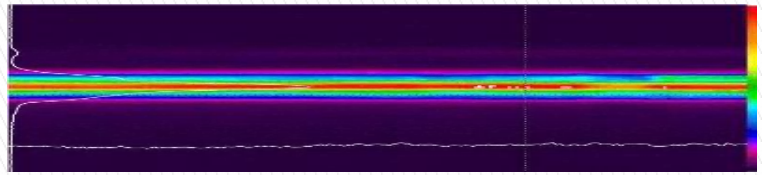
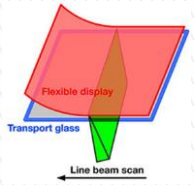
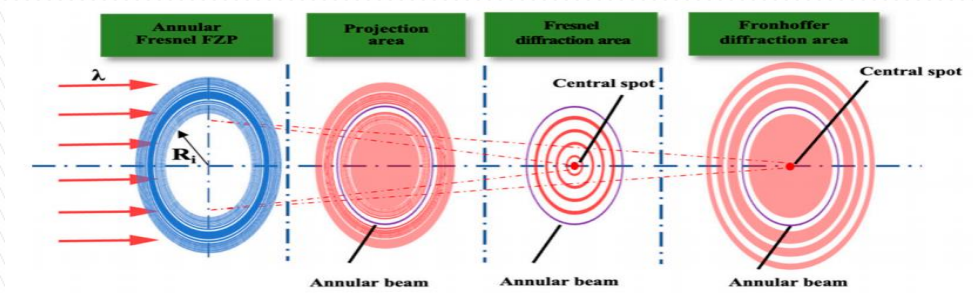
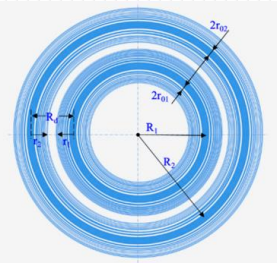
※ Operation Mode

작동 방식	Dual Mode			IFOV	R2R	Remark
	Scan Mode	Direct Writing(Fixed Optics)			MOTF	
		Objection Lens + Motion Stage	Scanner + Motion Stage			
Model	μ-Lab, μ-Fab	μ-Fab		μ-Fab-I, μ-Gan	μ-R2R	
개념도						
Laser	355nm, 532nm	355nm, 532nm, 1064nm		355nm, 532nm, 1064nm(1 selection)	355nm, 532nm, 1064nm(1 selection)	
특징	레이저 빔 이동 (거울이용) 가공물(stage) 고정	레이저 빔 고정 가공물(Stage) 이동		레이저 빔 이동 가공물(stage) 이동	레이저 빔 이동 가공물(stage) 단방향(x축) 이동	
Travel Range	≤ 200mm X 200 mm (小)	≤300x500mm (中)		≤500x500 ~ 1000X 1000mm (大)	Web width (200~300mm)	
가공속도	5~7m/s 까지 가능	1~ 1.5 m/s 이하		1~ 1.5 m/s 이하	3M / min	
곡선	O	△		O	△	
직선	O	O		O	O	
동영상	www.kortherm.com					
Applications	Glass / Polymer / Wafer / Thin metal/ Film / Silicon wafer DISPLAY (FPD, AMLCD) / Solar Cell (Perovskite, OPV, CIGS등) / Bio sensor					
Option	- Beam Profile(Tophap, Bessel Beam) - IFOV					

※ Beam profile

Gaussian Beam	• Typical shape of Laser Beam • Energy is concentrated in center	 Gaussian Beam Shape and Energy distribution	 Wavelength : 532nm
Tophat Beam **(Flat top Laser Beam)**	• Modulated Beam of Gaussian • It have constant energy density • It make uniform Laser Processing result • Power is lower than Gaussian	 Top-Hat Beam Shape and Energy distribution	
Bessel Beam	• Beam have long focus position • It use process of Transparent material like glass, sapphire, quartz.	  Bessel Beam Diameter 2-3μm by Axicon Lens | Energy distribution of Bessel Beam	 Wavelength : 1064nm

※ Beam profile

Line Beam	• Modulated Beam of Gaussian to narrow line • It use lower power, make same power density in a thin line by lower cost.	  
Maskless Beam by SLM	• Light transmitted by SLM can be reshaped to desired shape • It make single laser beam to split multi beam	
Annualr Beam	• High efficiency and flexibility • Apparent bright spot at the center	 

KOS Innovative Laser Technology

목차

1. μ-Lab1

❖ Specification

Laser pulse width	NANO / PICO / FEMTO
Wavelength	355nm(UV)/ 532nm(Green)/ 1064nm(IR) : 1 Wavelength
Operating mode	Scan mode
Traveling range	200mm x 200mm
Dimension (W/D/H)	1,600mm x 1,200mm x 1900mm
Accuracy	≤ ±0.5um
Reliability	≤ ±0.5um
Working type	Patterning / Scribing / Cutting / Drilling
Application	Glass / Polymer / Wafer / Thin metal/ Film / Silicon wafer
	DISPLAY (FPD, AMLCD) / Solar Cell (Perovskite, OPV, CIGS등)
	Bio sensor

* 핵심 기술 :

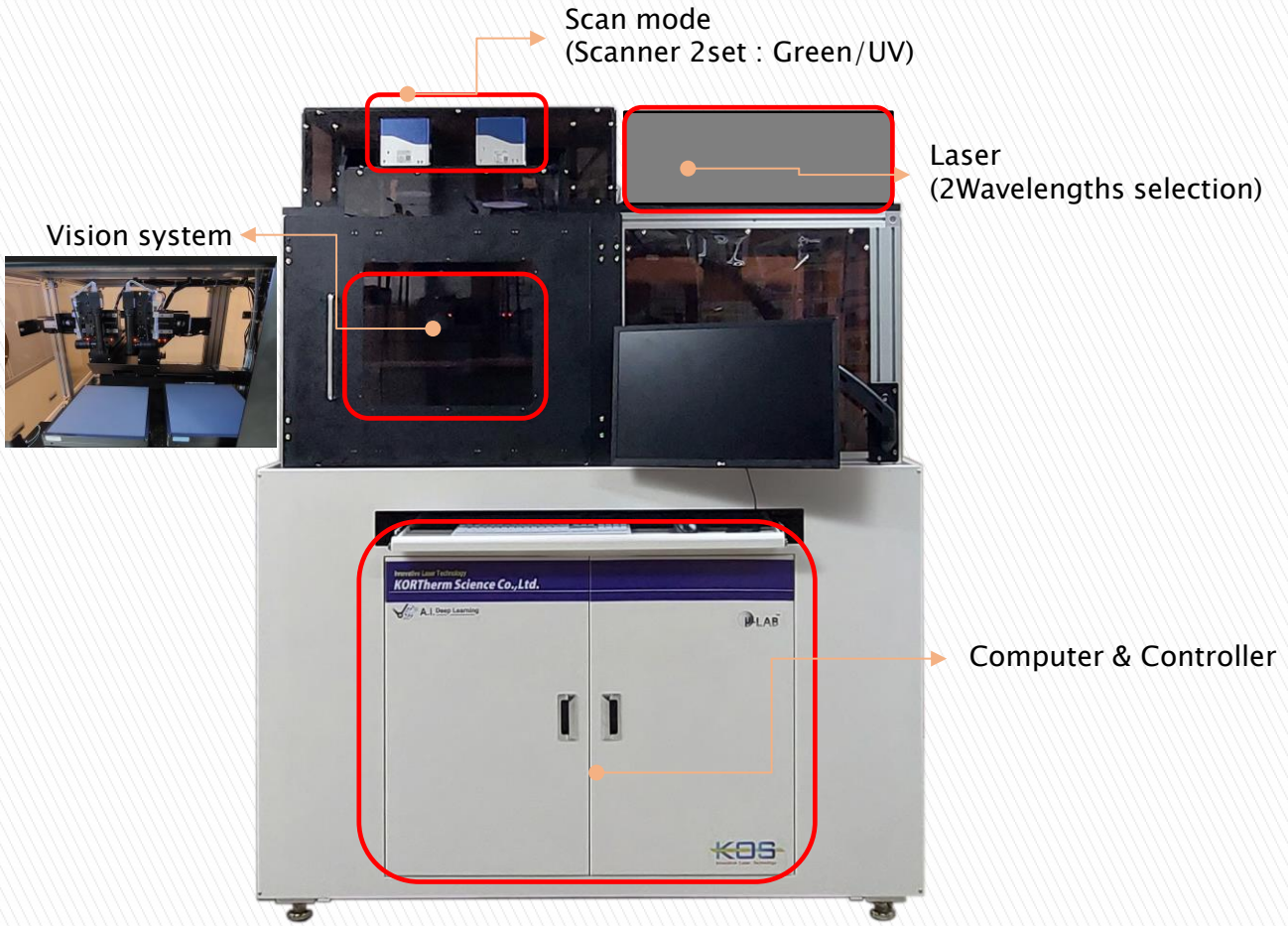
1) Vision Alignment 를 통한 패턴 인식 및 정렬
2) Multi 기능이 가능한 강력한 소프트웨어 구성
   - Measure Function
   - Laser Spot Overlap & Fluence Calculation
   - Control Laser Parameter
   - A.I adoption

2. μ-Lab-S2

❖ Specification

Laser pulse width	NANO / PICO / FEMTO
Wavelength	355nm(UV)/ 532nm(Green)/ 1064nm(IR) : 2 Wavelengths
Operating mode	Scan Mode (Scanner 2set : Green / UV)
Traveling range	200mm x 200mm
Dimension (W/D/H)	1,600mm x 1,200mm x 1900mm
Accuracy	≤ ±0.5um
Reliability	≤ ±0.5um
Working type	Patterning / Scribing / Cutting / Drilling
Application	Glass / Polymer / Wafer / Thin metal/ Film / Silicon wafer
	DISPLAY (FPD, AMLCD) / Solar Cell (Perovskite, OPV, CIGS등)

- **핵심 기술 :**
  1) **2 Wavelength 적용으로 선택적으로 사용**



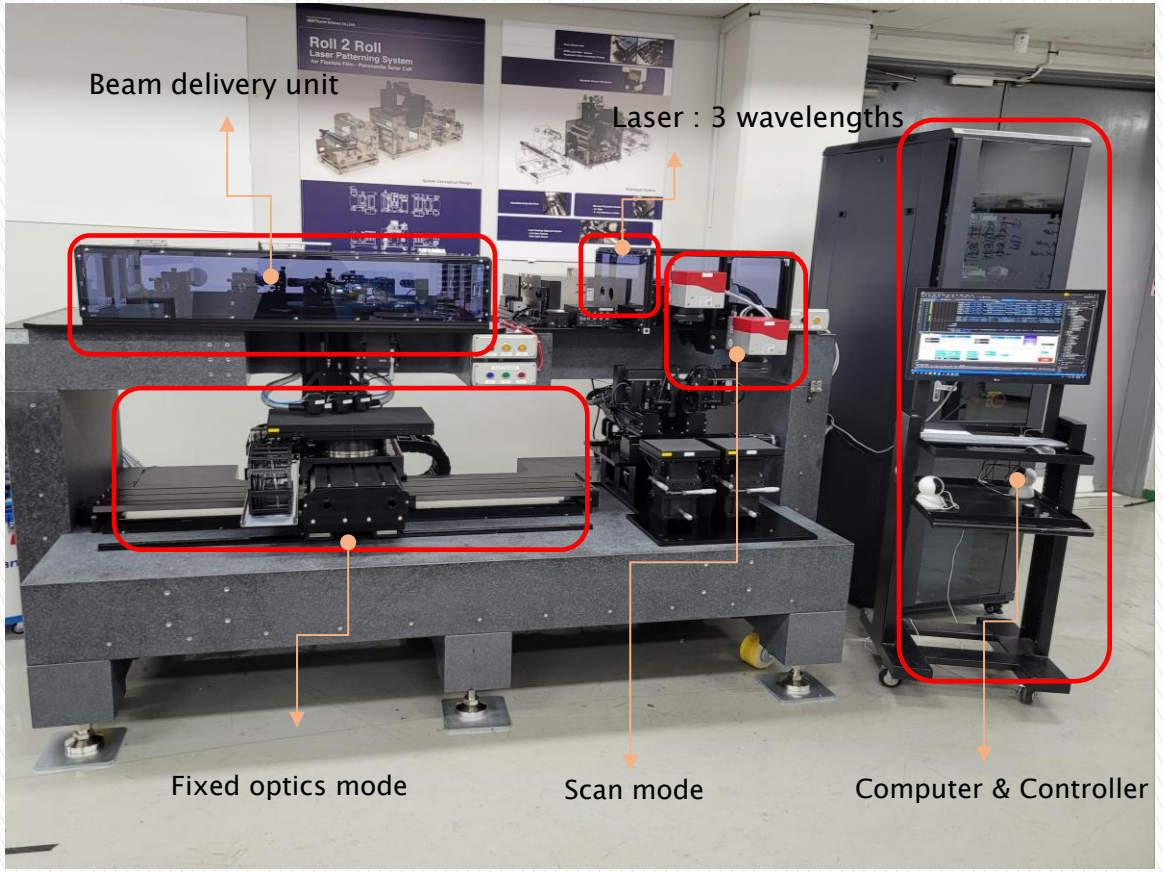
3. μ-Fab-D2 (Dual Mode : Fixed Optics / Scan)

❖ 주요 구성품

Laser	355nm(UV)/ 532nm(Green)/ 1064nm(IR) : 3 Wavelengths
Fixed optic mode	355nm, 532m, 1064 nm 사용 가능
Scan mode	2 set (355nm, 532nm 사용 가능)
Option	Bessel beam, Tophap beam

❖ 주요 spec.

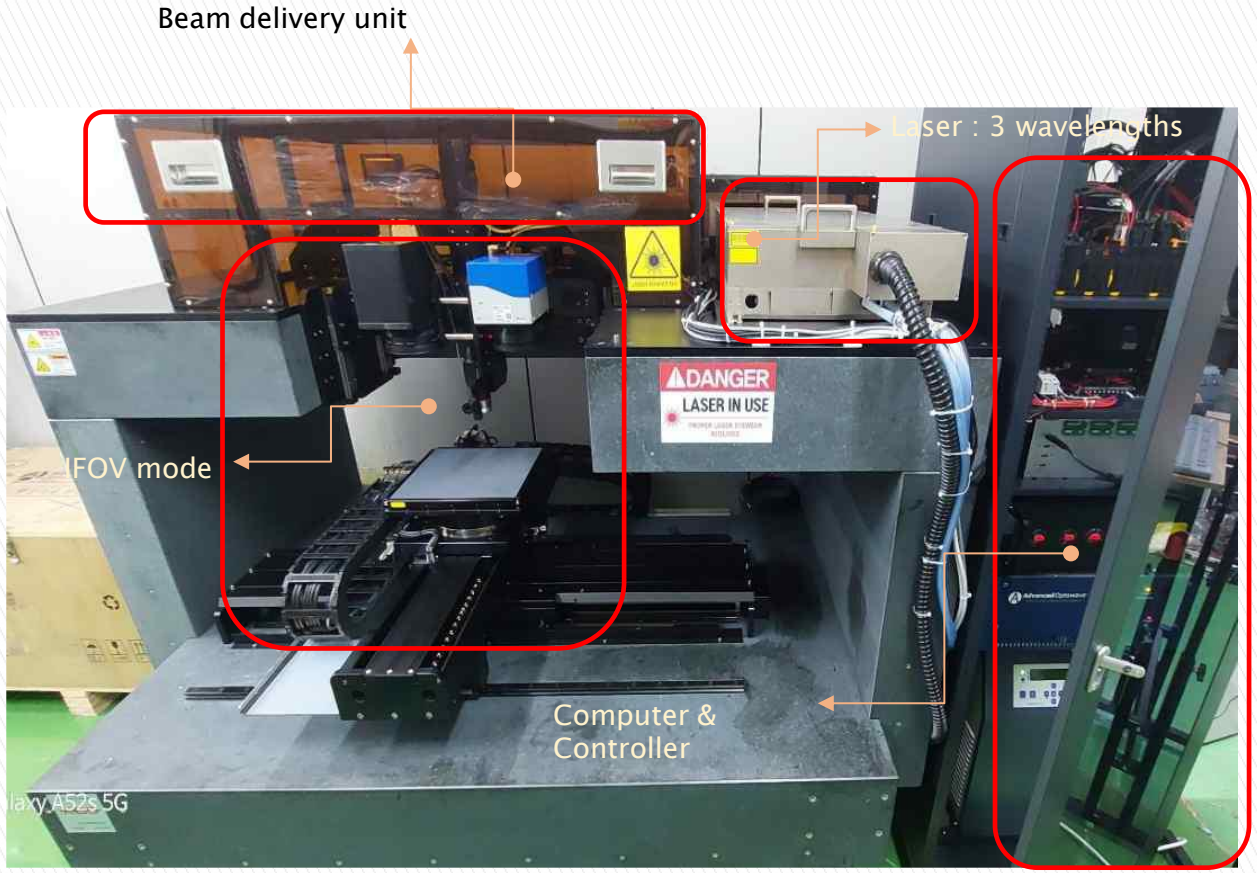
Laser	40W(1064nm)/ 20W(532nm)/ 10W (355nm)
	Repetition rate : 0.2 ~ 1MHz
spot size	≤ 25um (1064nm),15um(532nm),12um(355nm)
Substrate size	Motion stage : ≤ 500X300mm Scanner : ≤180X180mm
Speed	Fixed optics mode : ≤ 1.5 m/s Scan mode : ≤ 7 m/s
Accuracy	≤ ±0.5um
Reliability	≤ ±0.5um
Dimension(W/D/H)	2700X1500X2100mm



4-1. μ-Fab-I [IFOV (Synchronization)]

❖ 주요 spec.

Laser pulse width	Nano / Pico / Femto
Wavelength	355nm(UV)/532nm(Green)/1064nm(IR) / 2 Wavelengths
Operating mode	Dual mode (Fixed Optics / Scan) IFOV (Synchronization : Scan + Fixed Optics)
Traveling range	Max 600mm x 600mm
Working type	Patterning / Scribing / Cutting / Drilling
Application	Transparent material(Quartz, Sapphire, Glass wafer 등)
	TGV(Through Glass Via), TSV(Through Silicon Via)
	3D Micro/Nano Structures
	박막 유리 가공
	Polymer / Wafer / Thin metal/ Film / Silicon wafer
	DISPLAY (FPD, AMLCD) / Solar Cell (Perovskite, OPV, CIGS등)

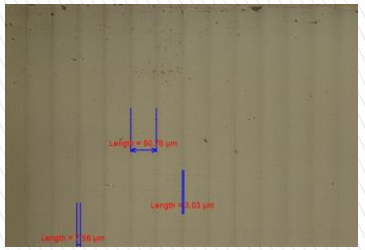


※ IFOV : Infinite Field Of View

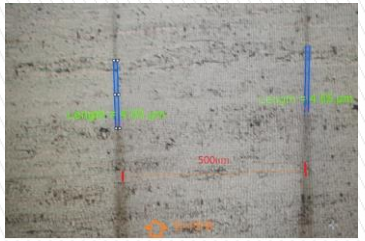
4-2. μ-Fab-I [IFOV (Synchronization)]

❖ **Glass Hole Drilling Machine 적용시 성능**

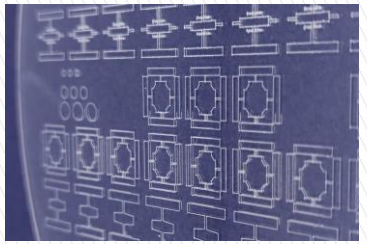
Attribute	Capability
Processing type	TGV, Open and closed cavities, Trenches, Blind Vias
Outer Diameter (OD)	10~100μm
TGV Drilling rate	~10,000 TGV / s
Min. Pitch	5μm
Taper angle	0° ~ 10°
Sample Size	Wafer-Level Proccesing (~12")
Material type	All of Transparent material (Sappahire, Borosilicate, Quartz, etc)
Accuracy	± 1 μm
Thickness	50~1000μm
Remark	No Burr/ Microcracks /Debris/ Chipping



Modification Inside Glass
Wavelength : 1030nm
Thickness : 1mm

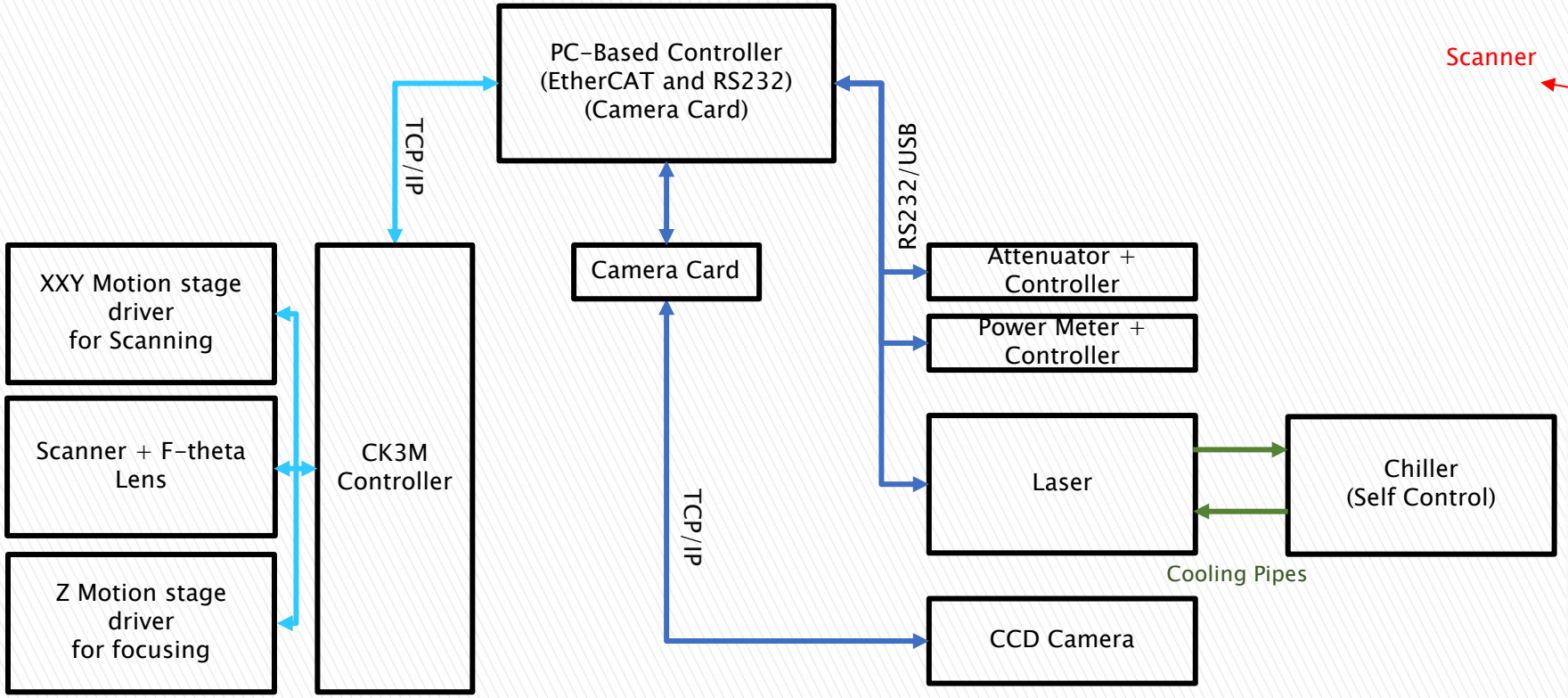


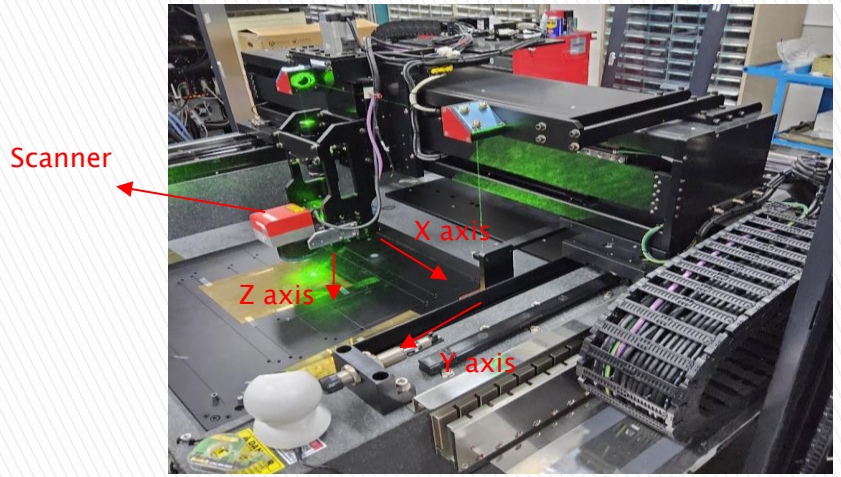
Borosilicate Glass
(Bessel beam)
Wavelength : 1030nm
Thickness : 1mm

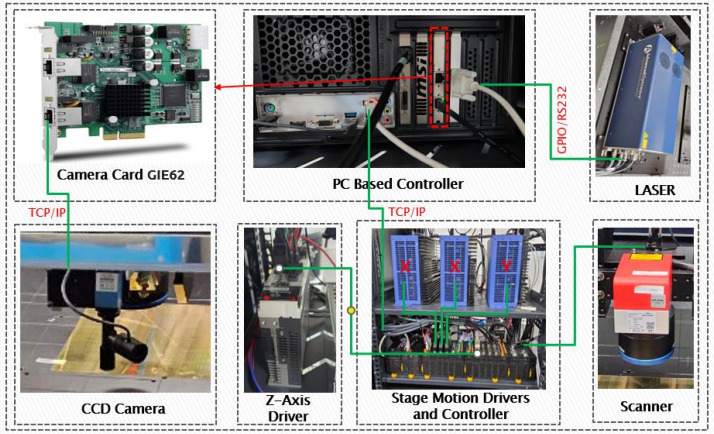


Borosilicate Glass
3.3(Dia 6", 웨이퍼)
Wavelength : 1030nm
Thickness : 1mm

4-3. μ-Fab-I [IFOV (Synchronization)]



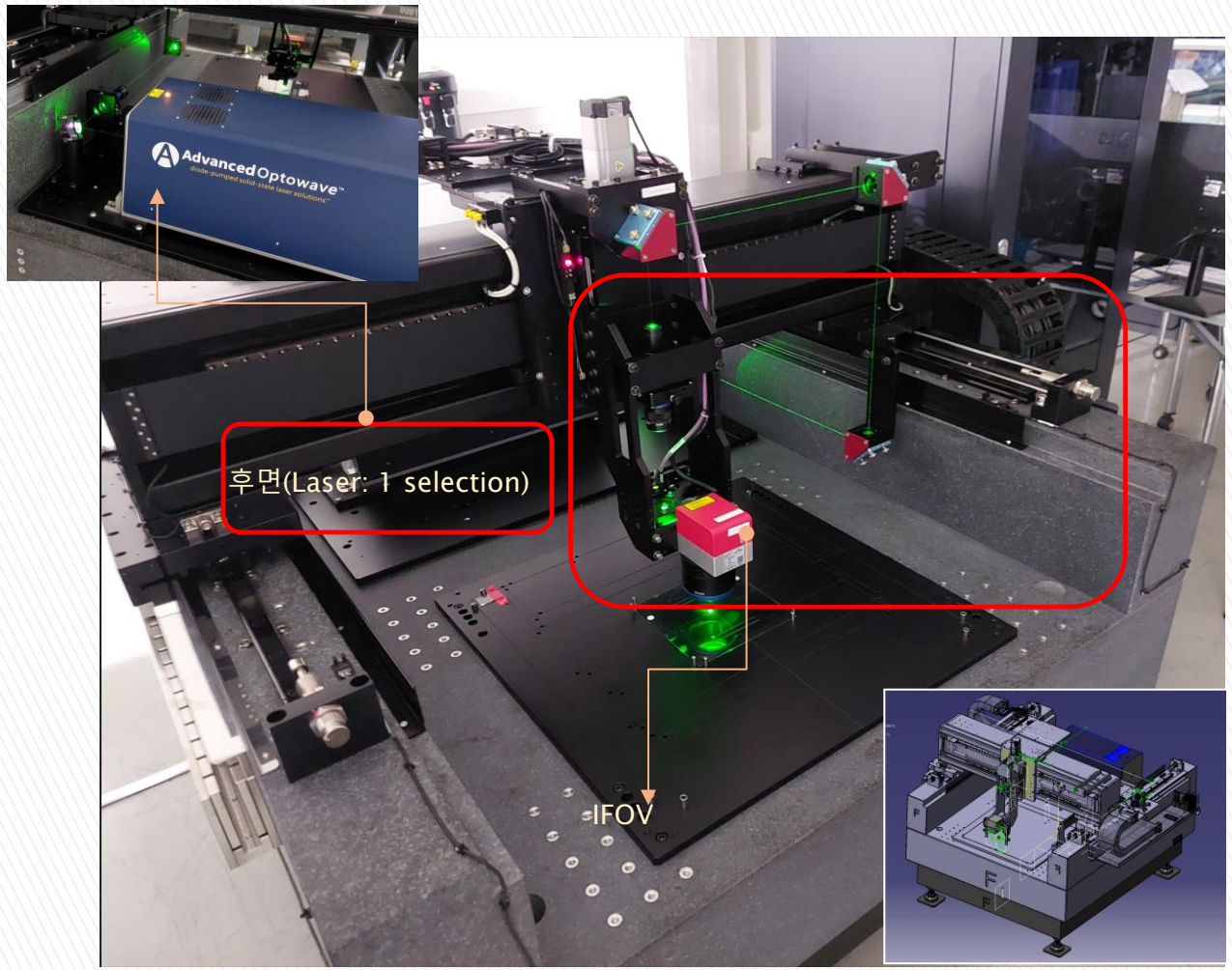




5-1. μ-Gan (Laser Patterning Machine based on Gantry System)

❖ 주요 spec.

Laser pulse width	Nano / Pico / Femto
Wavelength	355nm(UV)/532nm(Green)/1064nm(IR) / 1 Wavelength
Operating mode	Fixed Optics mode / IFOV
Traveling range	1000 mm(X) X 1000 mm(Y)
Working type	Patterning / Scribing / Cutting / Drilling
Application	Glass, Polymer / Wafer / Thin metal / DISPLAY (FPD, AMLCD) / Solar Cell (Perovskite, CIGS등)



5-2. μ-Gan (Laser Patterning Machine based on Gantry System)

❖ **Glass micromaching system feature**

Attribute	Capability
Processing type	TGV, Open and closed cavities, Trenches, Blind Vias
Outer Diameter (OD)	10~100μm
TGV Drilling rate	~10,000 TGV / s
Min. Pitch	5μm
Taper angle	0° ~ 10°
Sample Size	Panel-Level Proccesing (515mm x 510mm)
Material type	All of Transparent material (Sappahire, Borosilicate, Quartz, etc)
Accuracy	± 1 μm
Thickness	50~1000μm
Remark	No Burr/ Microcracks /Debris/ Chipping

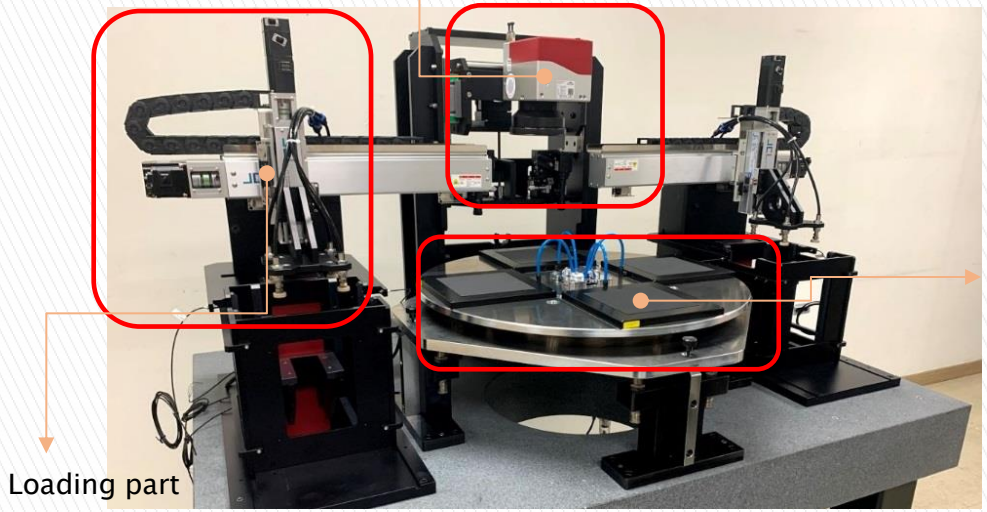
6. μ-WTU (Laser Scriber with Wafer Rotary Unit)

❖ 주요 구성품

Wavelength	355nm(UV)/532nm(Green)/1064nm (IR) / 선택 가능
Scanner	180mm X 180mm
Rotation stage	Wafer 4개 장착
Loading/ unloading Part	Cassette (공정 ~이송)

❖ 주요 spec.

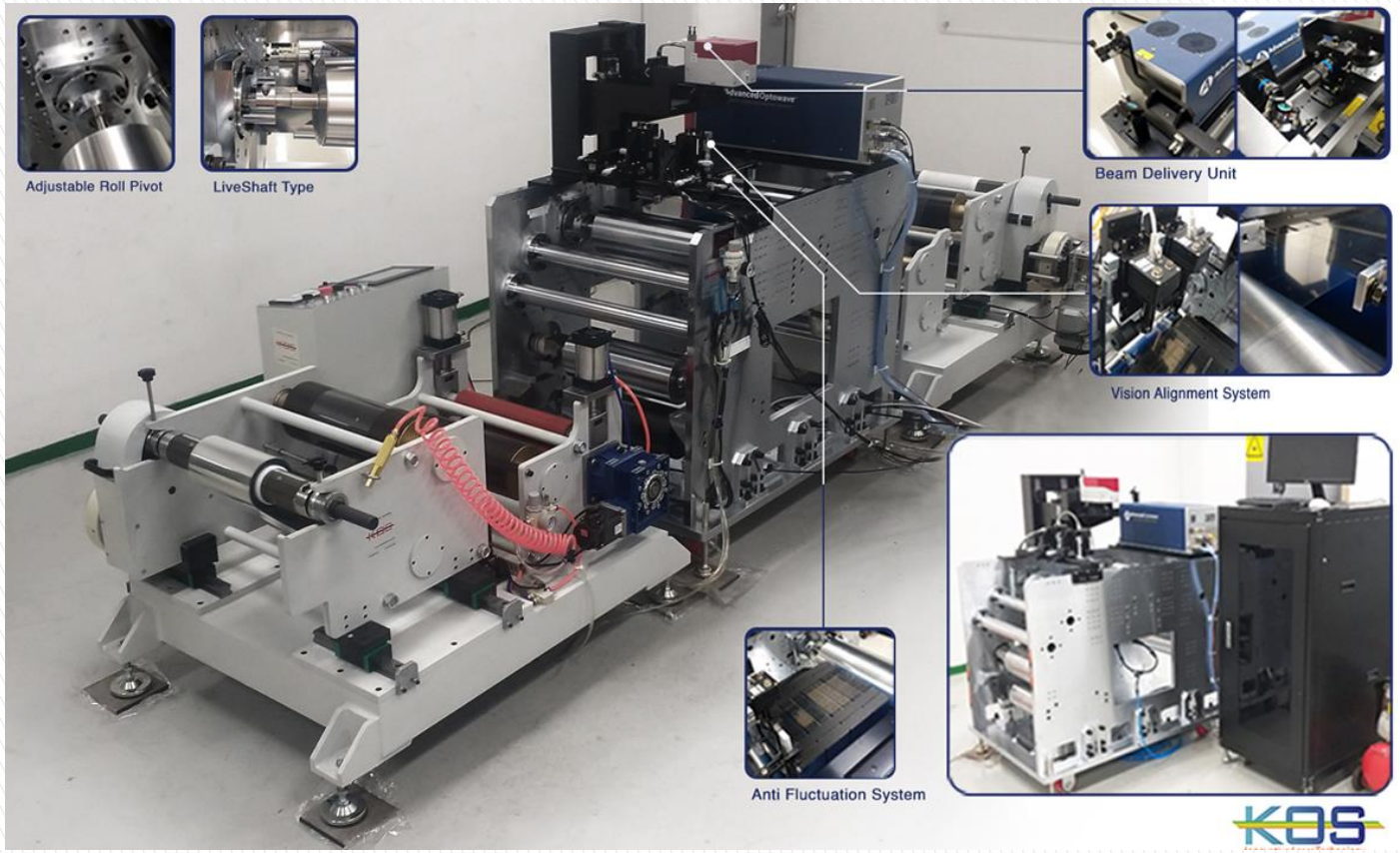
Laser	10W (532nm)
	Repetition rate : 0.2 ~ 1MHz
Substrate size	≤ 200X200mm(변경 가능)
Substrate thickness	0.05 ~ 3t (mm)
Speed	7 m/s
선폭	≤ 15 um
Accuracy	≤ ±0.5um
Dimension(W/D/H)	3000 X 1500 X 1700 mm
Throughput	-



7. μ-R2R (Laser Patterning Machine based on Roll to Roll)

❖ 주요 spec.

Laser pulse width	Nano / Pico / Femto
Wavelength	355nm(UV) / 532nm(Green) / 1064nm(IR) / Single only
Operating mode	MOTF
Traveling range	200mm / 공정속도 Minimum 3M / min
선폭정밀도	2μm 이하
위치정밀도	≤±50μm at 3M/Min
Application	Pevrovskite Composite / Film 등 유연 소재 Printed Electronics(인쇄 전자)
Dimension(W/D/H)	4500 X 2000 X 2000 mm

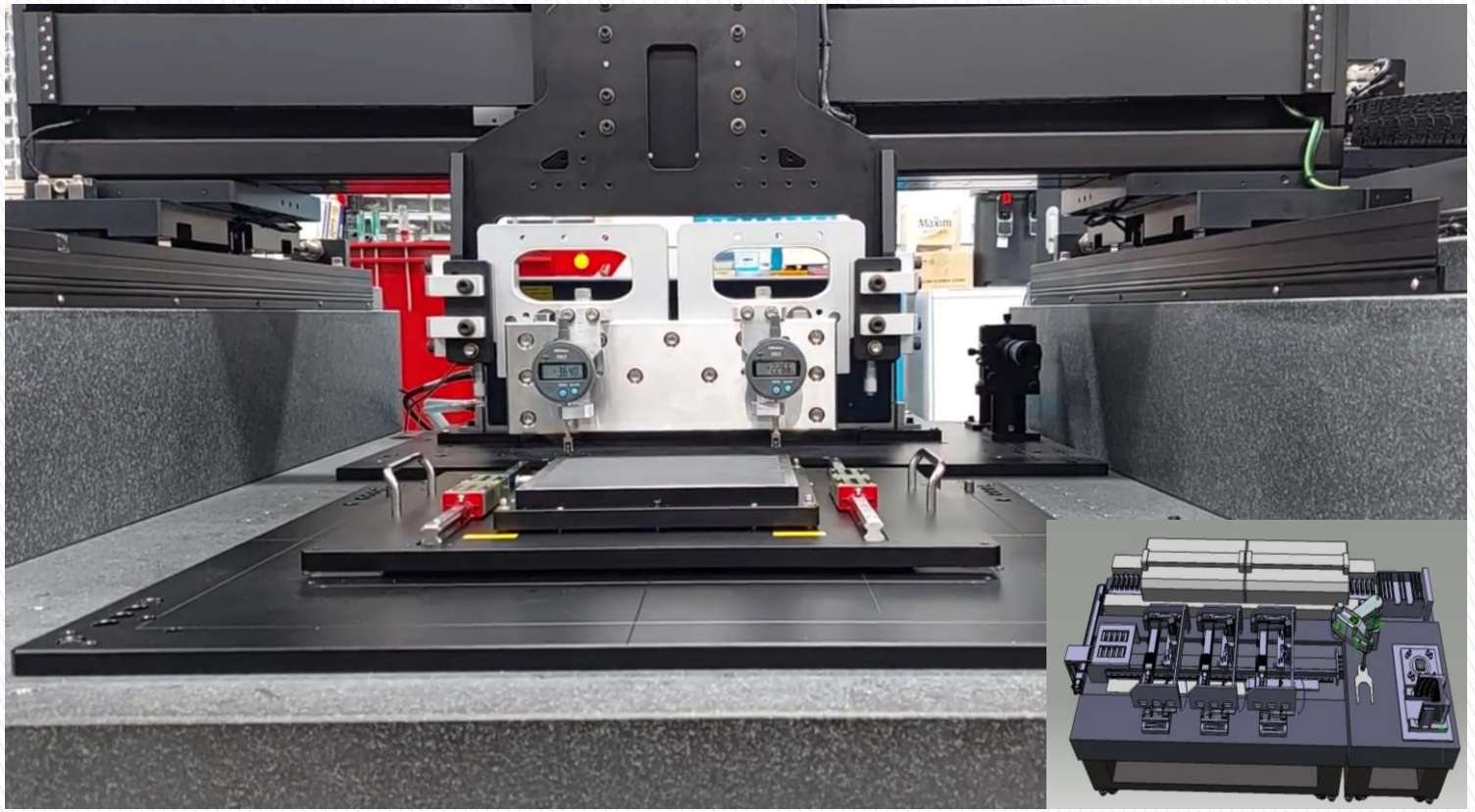


※ MOTF : Marking On the Fly

8. μ-Slot Die (Slot die Coating system)

❖ 주요 구성품

Slot die coater	3 set (lip cleaner 3set 포함)
Syringe pump	3 set (사용량에 따라 변경 가능)
Semi dry zone	Air knife dryer
IR dryer	Convey 기능 포함
Automation system	Wafer Cartridge 10 sheet Loading / unloading Robot Transfer stage (Coating -> Dryer)



❖ 주요 spec.

Substrate size	200X200mm Glass(0.7~ 3mm)
Coating area	~ 160x160mm
Coating Speed	1~ 200mm/s
IR zone	2mm **(** ≤ 150℃)
Outline Dimension	3,500 X 1,750 X 1600 mm

※ 고객 요청에 따라 spec. 및 구성 변경 가능

9. Glass Hole Drilling Machine

◆ Specification

Laser Pulse Duration	PICO / FEMTO
Wavelength	532nm(Green)/ 1064nm(IR) - 1 종류 적용
Operating Mode	IFOV
Traveling range	300~600 mm (X) x 300~600 mm (Y)
Working Dimension	1000 mm (X) x 1000 mm (Y) x 50mm (Z)
Working Type	Modification Inside Glass / Drilling
Application	Transparent Material (Quartz, Borosilicate, Sapphire, Glass, wafer 등)

* 핵심 기술 :

1) Axicon – Convex 구성으로 Bessel beam 을 구현

2) 멀티 Beam을 통한 Material에 따른 파장 선택 가능

10. Maskless Laser Lithography (DMD: Digital Micro-mirror Display)

◆ Specification

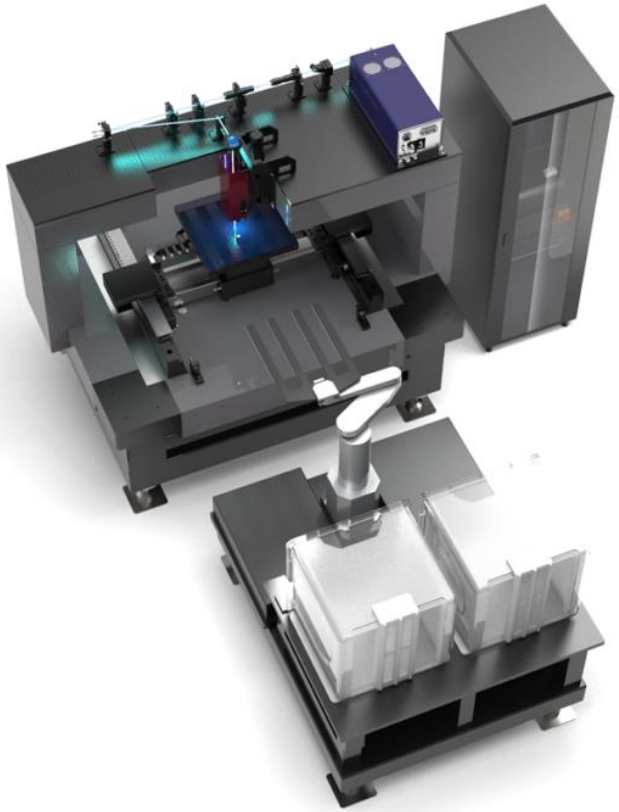
Wavelength	355nm(UV-A)/ 365nm(UV-A) / 248nm(UV-C) - 1 종류 적용
Operating Mode	Direct Writing & DMD
Traveling range	300~600 mm (X) x 300~600 mm (Y)
Working Type	Lithography, Exposer, Patterning
Application	PR(Photo Resist), DFR(Dry Film Resist) Maskless RDL(Reditribution Layer) 제작
Working Dimension	1800 mm (X) x 1600 mm (Y) x 1650 mm (Z)

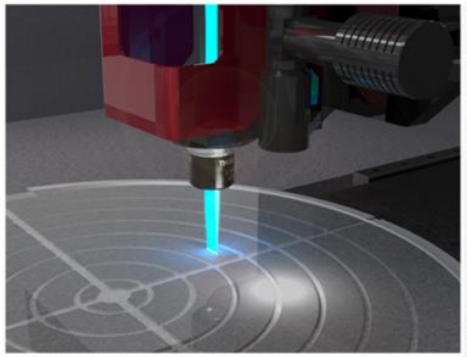
*** 핵심 기술 :**

1) DMD를 적용하여 Circuit Patterning 공정 구현

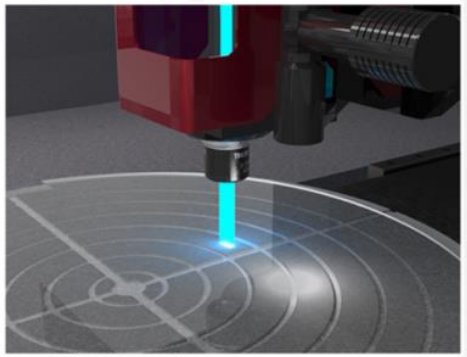
2) Substrate RDL(Redistribution Layer) 공정 가능, TGV Glass, PCB

3) Stitching Error 보정





SLM (PLV, GLV) - Line Shape Beam

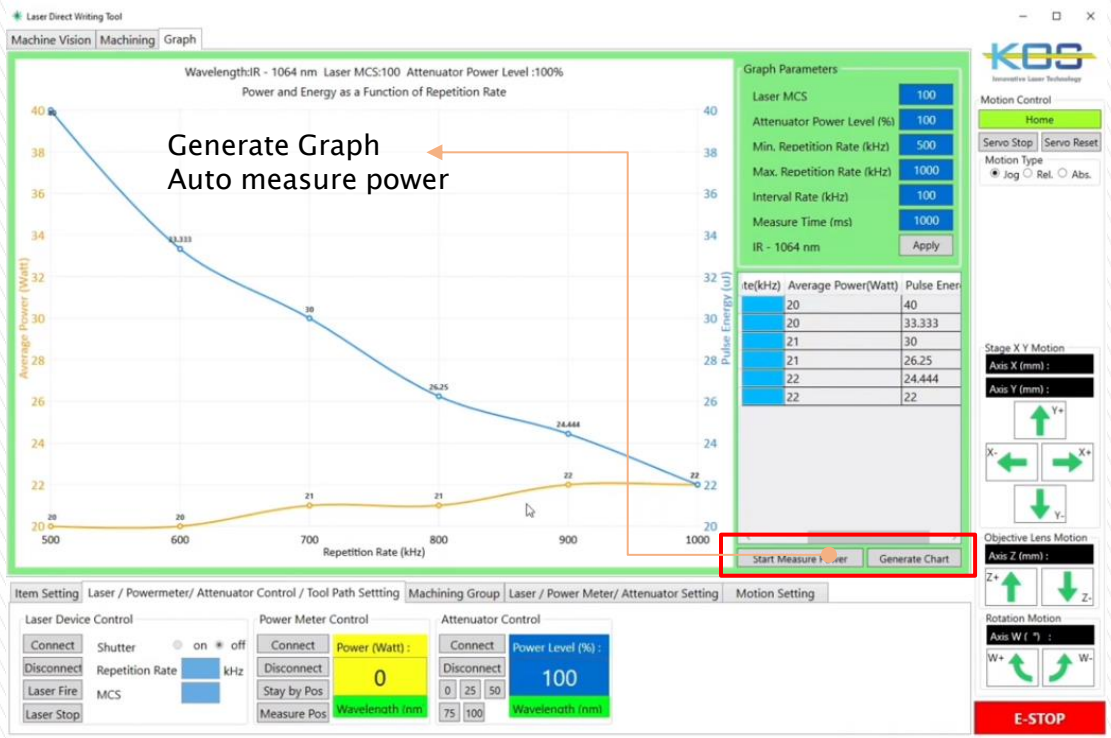


DMD - Area Beam

11. 주요 기능 소개

❖ Auto measure power / Generate Graph

-Repetition rate 에 따른 Power와 Pulse Energy
를 자동으로 계산 및 그래프 생성 가능



❖ Control Laser Parameter 기능

- 사용자가 최적의 공정 Parameter를 찾기 위하여 여러 번 반복 테스트를 진행 시,
한 번에 서로 다른 여러 Parameter 값을 가공 샘플에 적용하여 작업 효율을 높이는 기능

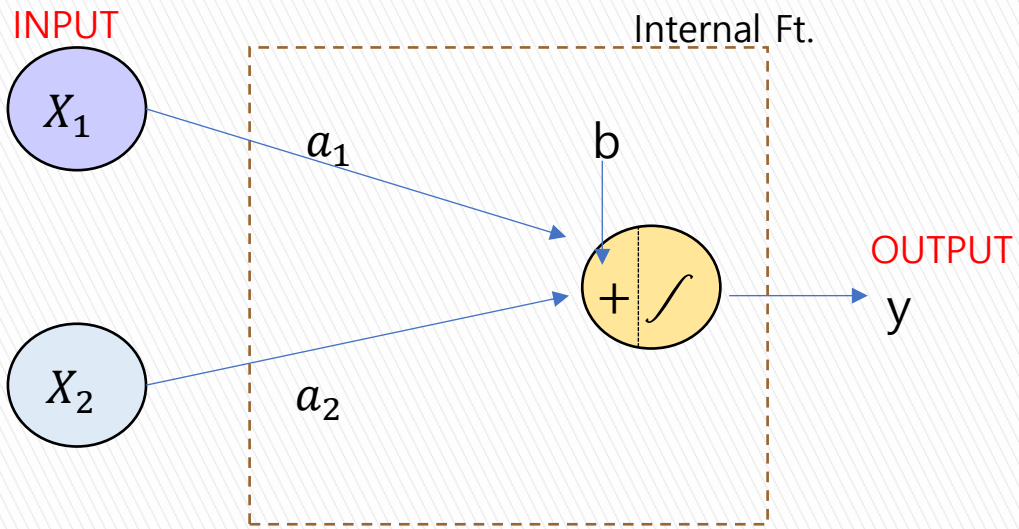
※ 주요 조정 Parameter: Power, Rep.Rate, Scan Speed, Pass(Repeat), Overlap(%)

Aligning Setting | Laser/ Powermeter/ Attenuator Control | Machining Group | Motion Setting | Laser/ Power Meter/ Attenuator Setting | Motion Calibration | WeldMark

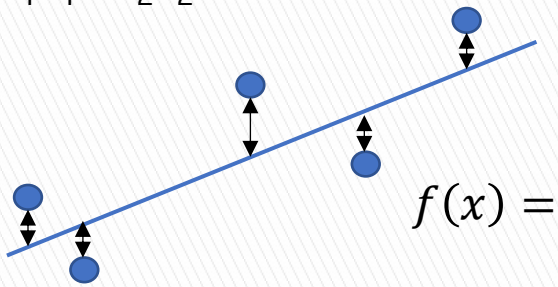
Power Level	Spot Dia.(um)	LSO(%)	Power (Watt)	Fluence(J/cm^2)	Attenuator Power Level(%)	Machining Z Offset (mm)	Pass #	Group Delay (s)	Group Note
100	20	99	10	6.36619772367581	60	-1	1	1	
300	20	99	10	6.36619772367581	100	-2	1	1	
300	20	99	10	6.36619772367581	100	0.5	1	1	
300	20	99	10	6.36619772367581	100	-1.56	1	1	
300	20	99	10	6.36619772367581	100	1.55	1	1	

11. 주요 기능 소개

❖ **AI adoption을 통한 공정 Parameter 최적화 기능**



$y=a_1x_1+a_2x_2+c$



$f(x)=ax+b$

$$E=\sum_k^n \left(y_k-f(x)\right)^2$$

Input

Overlapping(%), Repetition Rate(Hz), Scan Speed(M/s), Fluence(J/cm²)

Training Data(30ea), Test Data(50ea)

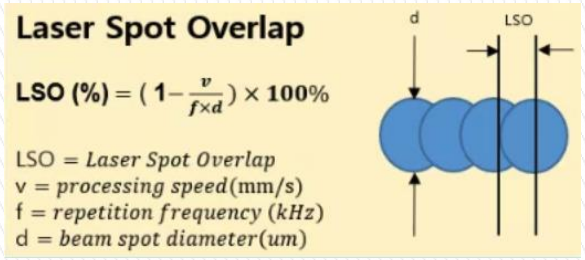
Output

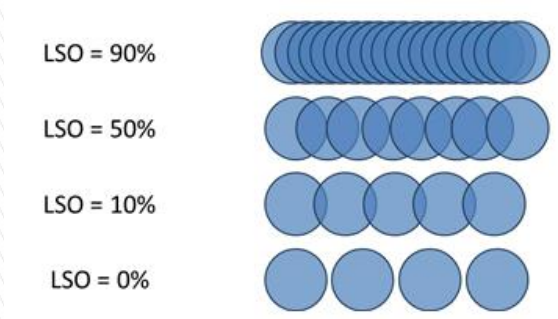
Ra(surface roughness;μm), Line Width(spot μm;)---
→PCE **(Power Conversion Efficiency)**

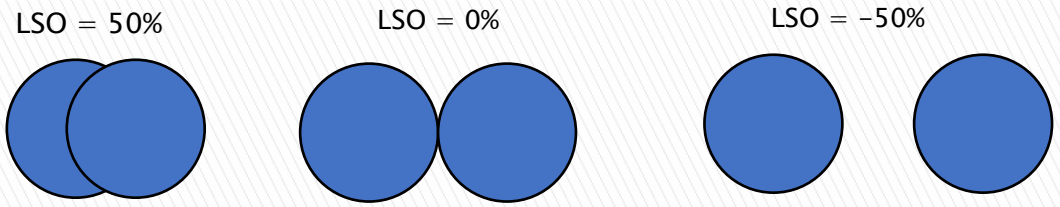
11. 주요 기능 소개

❖ Laser Spot Overlap – LSO(%)

- 3 개 변수(v,f,d)에 따라 LSO 값 결정
- 70%이상 설정으로 가공 품질 향상 가능
- LSO 공식





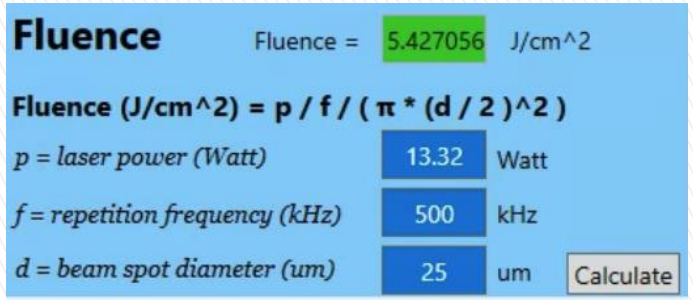


Input Input Input Output

no.	Processing Speed (mm/s)	PRF (kHz)	Power Level	Spot Dia.(um)	LSO(%)
1	9600	400	300	20	-20

❖ Fluence

- 단위 면적당 레이저 에너지 (J/㎠)
- 3개 변수(p,f,d)에 따라 Fluence 값 결정
- Fluence 통해 최적 Parameter 선정 가능
- Fluence 공식



Input Input Input Output

PRF (kHz)	Power Level	Spot Dia.(um)	LSO(%)	Power (Watt)	Fluence(J/cm^2)
400	300	20	-20	20	7.95774715459477

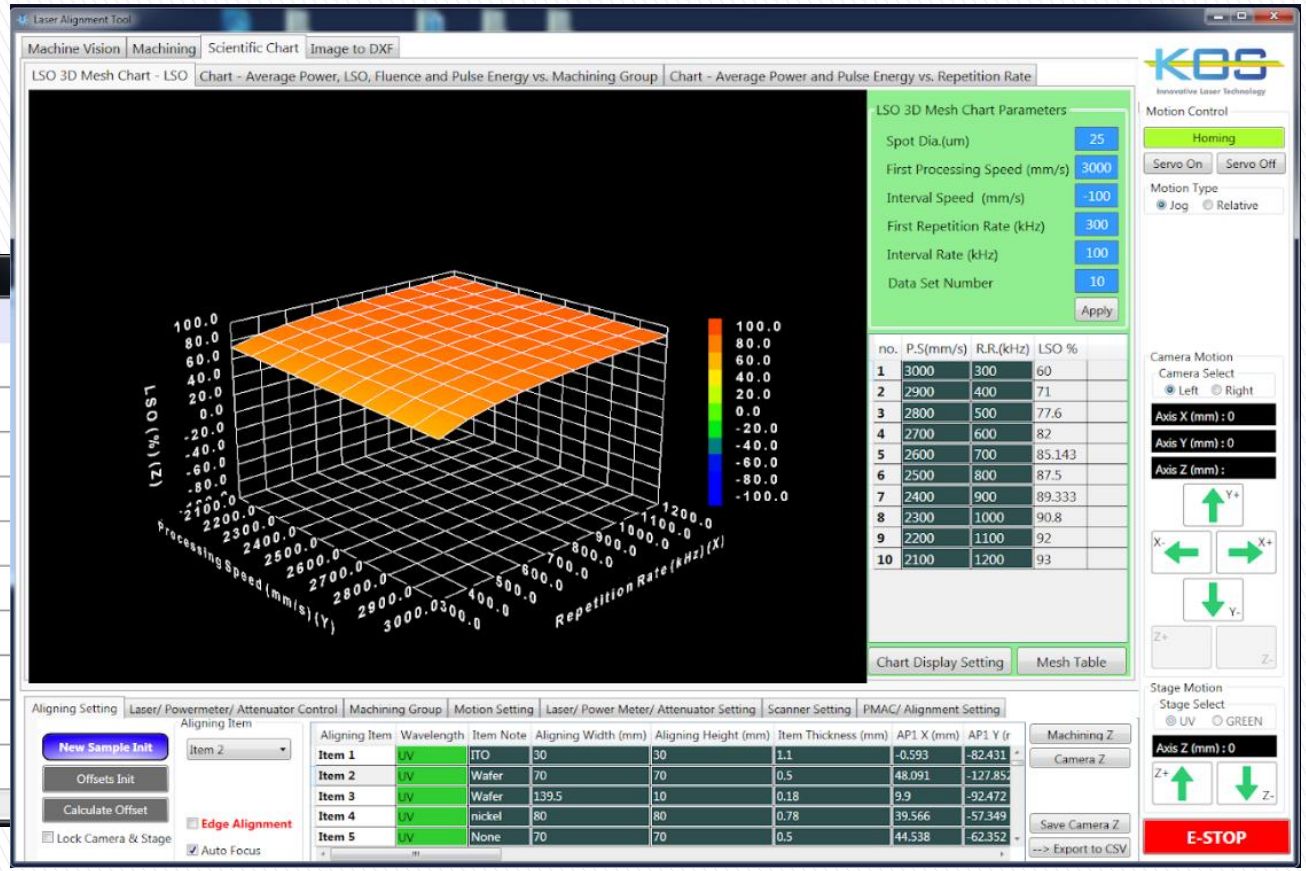
11. 주요 기능 소개

❖ LSO 3D Chart

- 2 개 변수(v,f)에 따라 LSO 값을 3D chart로 표현 가능

LSO Mesh Table

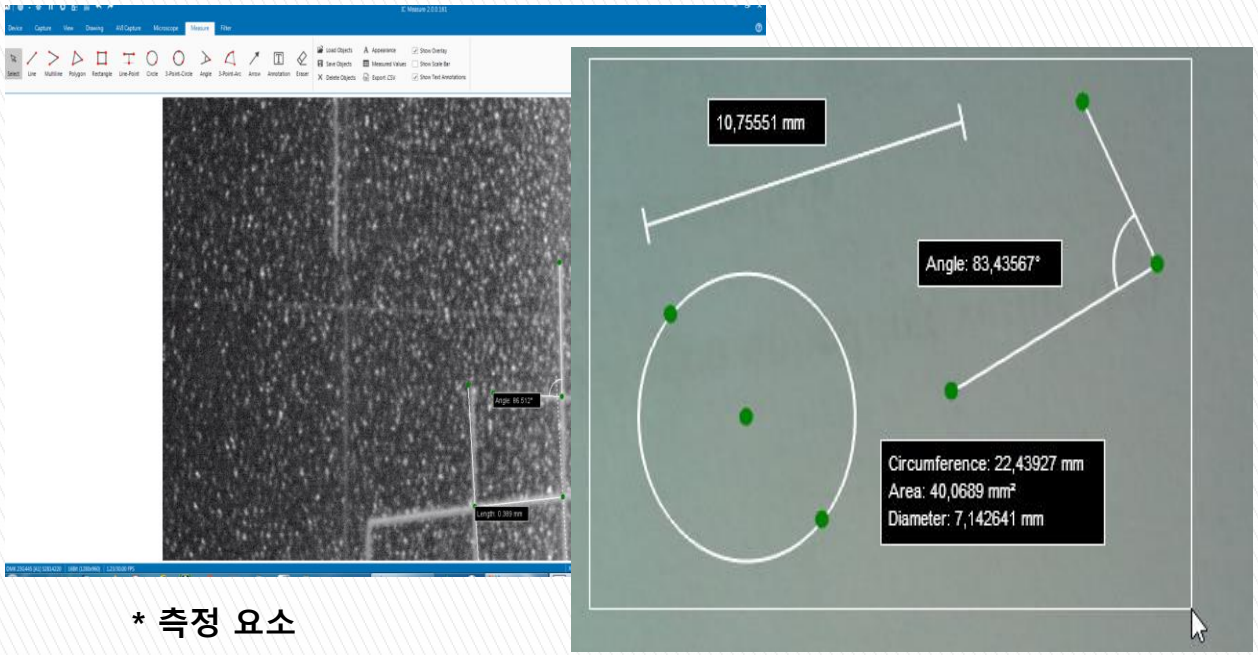
↓ P.S.(mm/s) /↘ LSO(%) for 25um /→ R.R.(kHz)	1200	1100	1000	900	800
2100	93	92.364	91.6	90.667	89.5
2200	92.667	92	91.2	90.222	89
2300	92.333	91.636	90.8	89.778	88.5
2400	92	91.273	90.4	89.333	88
2500	91.667	90.909	90	88.889	87.5
2600	91.333	90.545	89.6	88.444	87
2700	91	90.182	89.2	88	86.5
2800	90.667	89.818	88.8	87.556	86
2900	90.333	89.455	88.4	87.111	85.5
3000	90	89.091	88	86.667	85



11. 주요 기능 소개

❖ Measurement Function

- 최적화된 Vision system을 이용하여 미세 가공 데이터를 수치화 가능

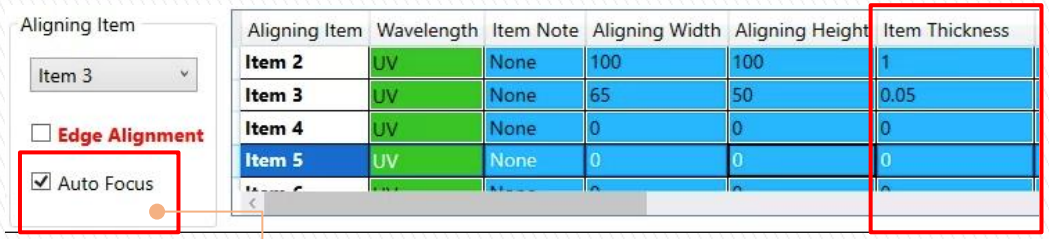


*** 측정 요소**

- **Spot Size**
- **Line width**
- **Line to Line Space**
- **Pattern Size**

❖ Auto Focus

- 시료 Thickness에 적합한 가공 Z 위치 선정
- ±5mm adjustable by motor

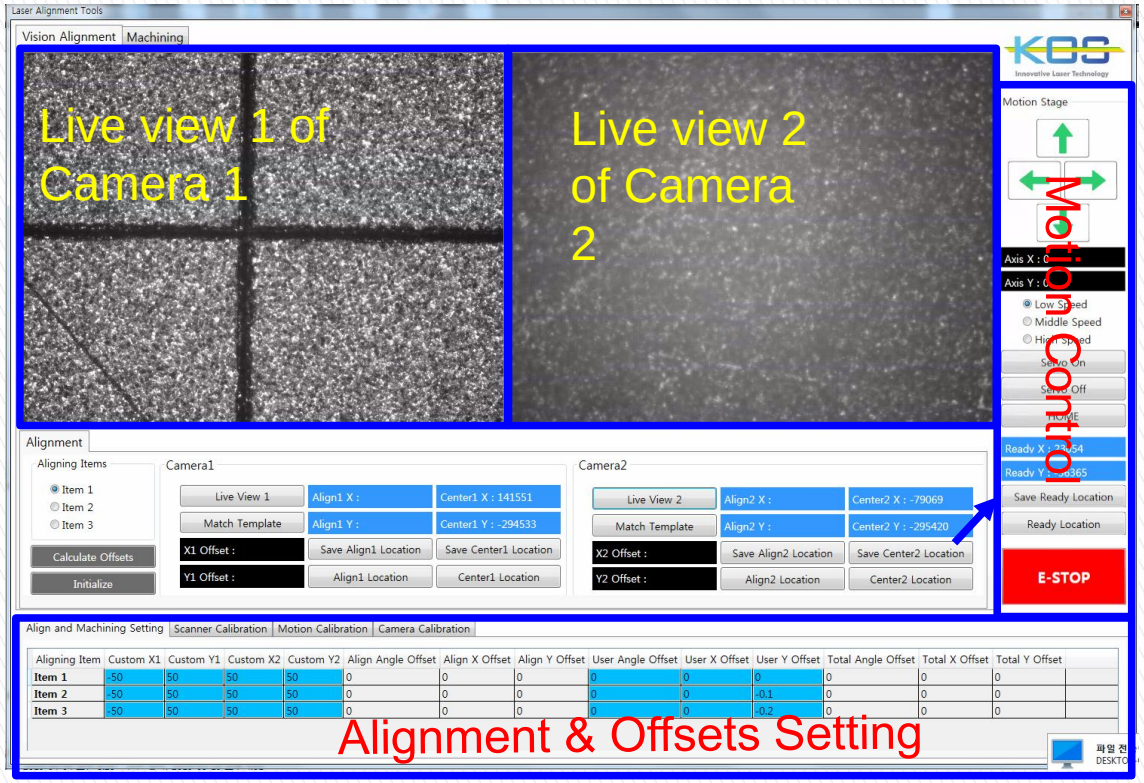


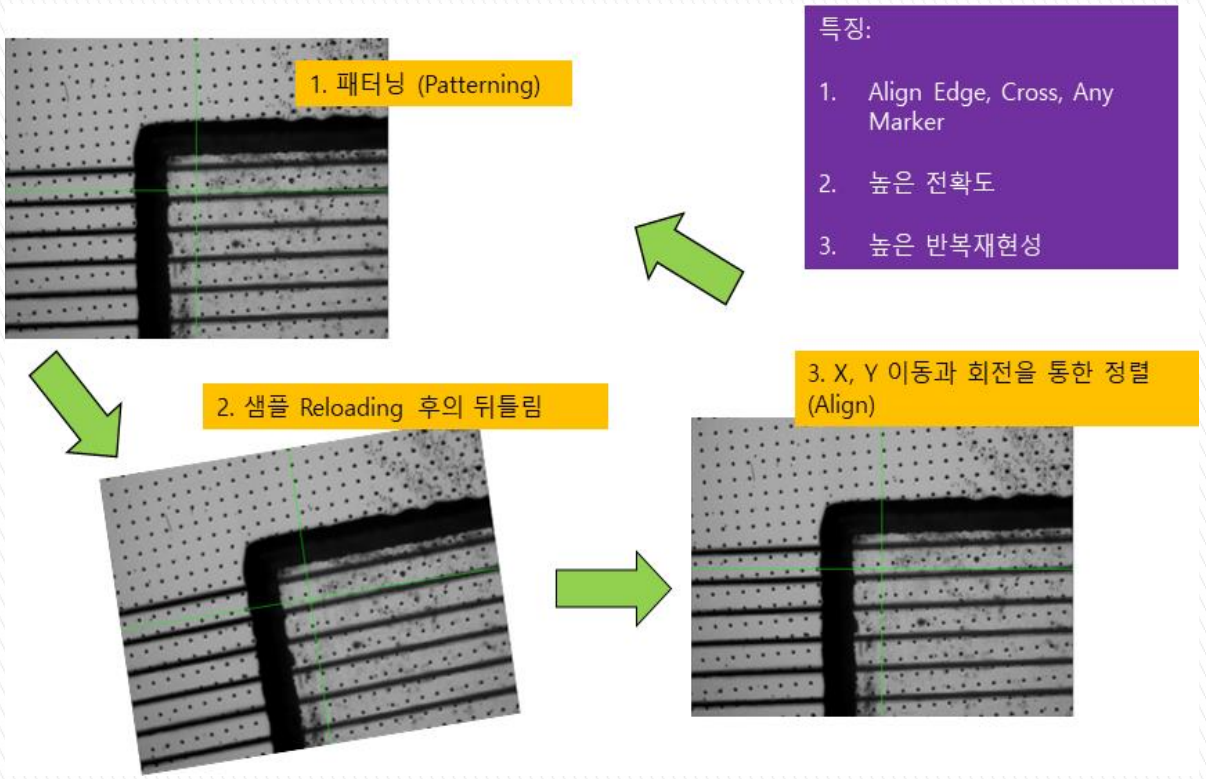
Auto Focus 클릭으로 적합한 가공 Z 위치 선정

11. 주요 기능 소개

❖ Auto Vision Align 기능

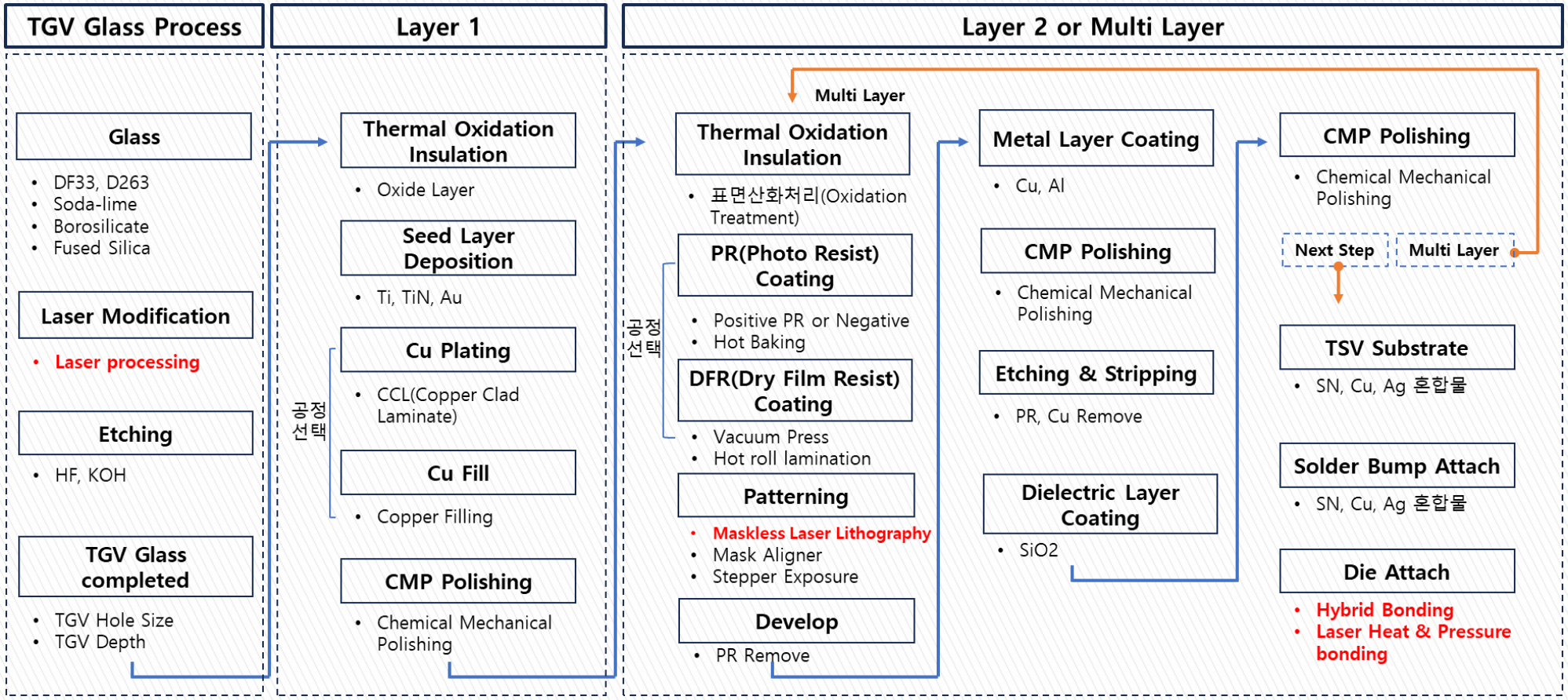
- 2대의 카메라를 이용한 Alignment
- 기판 크기 저장 가능(최대 50개)
- Edge, Marker Alignment 기능





11. 주요 기능 소개

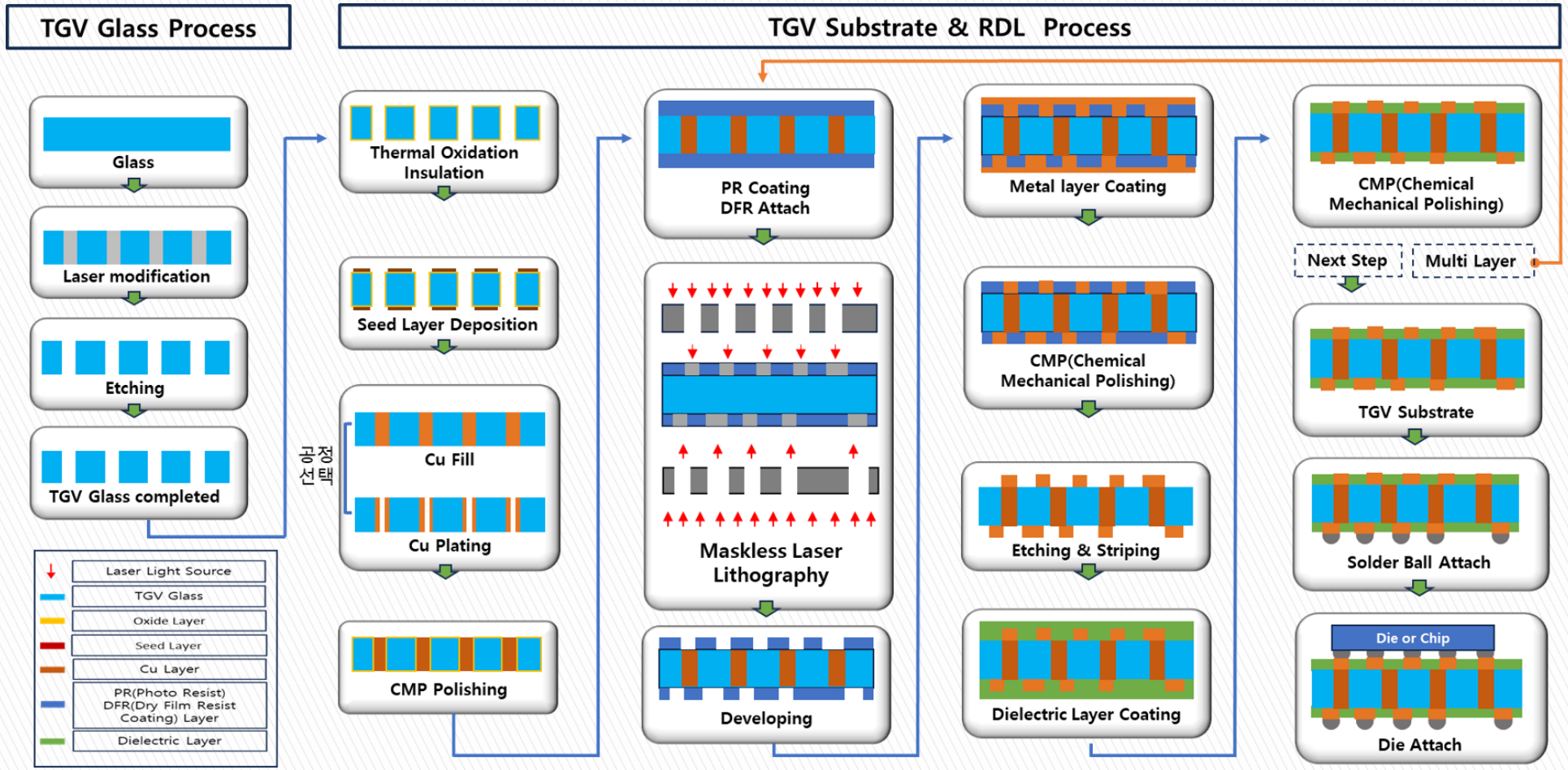
◆ Glass Substrate Fabrication Processes for Advanced Packaging



- 장점: TGV Glass와 RDL(Cu Circuit) 층을 주문 제작 방식으로 제작하며 생산 가능

11. 주요 기능 소개

◆ Glass Substrate Fabrication Processes for Advanced Packaging

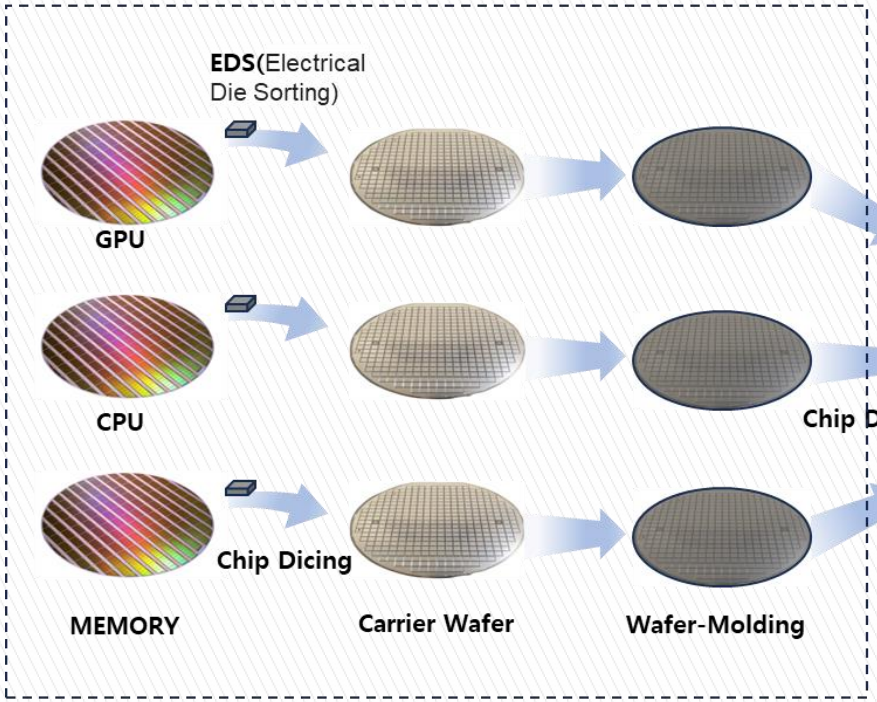


- TGV Glass Substrate 제작 Illustration

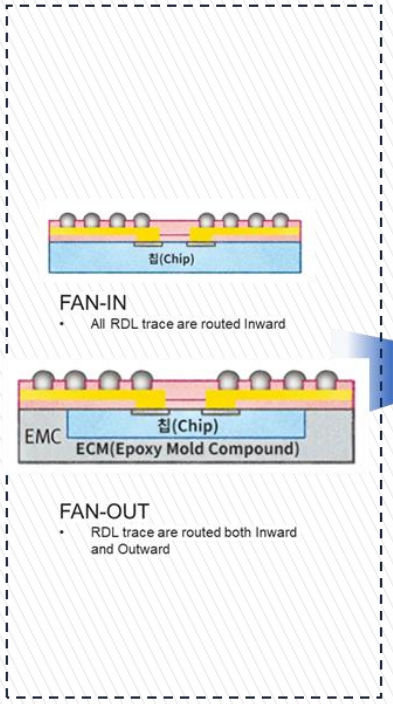
11. 주요 기능 소개

◆ Advanced Packaging – (FAN-IN, FAN-OUT)

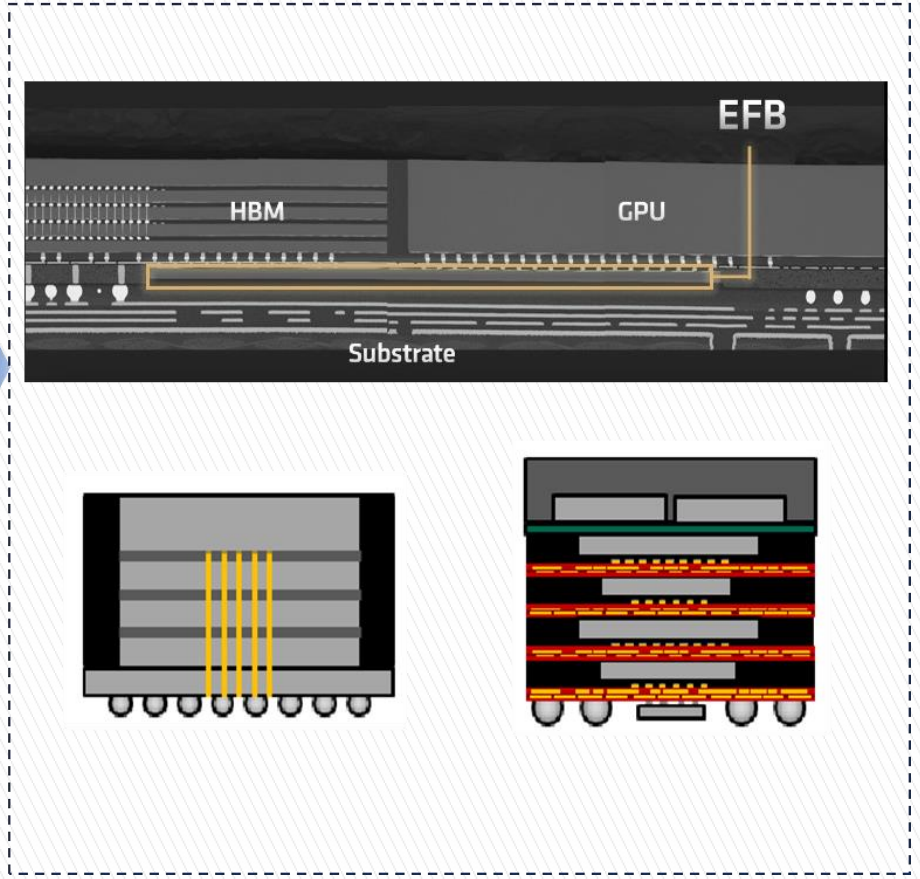
Molding & Dicing



Fan-In, Fan-Out Packaging



3D Stack Packaging



12. Sales Record

Applications

1.Solar Cell
(PSC/OPV/CIGS)

2.Display
(Flat Panel Display)

3.Semiconductor
(MEMS/Bio Sensor)

4.Transparent
Materials
(Glass, Polymer,
4H SiC)

국내 기업

LG전자 HYUNDAI 한화큐셀

정부산하 연구센터

- KIST (한국과학기술연구원), 한국생산기술연구원, 대구 나노팩
- 한국재료연구원, KERI(한국전기연구원)
- ETRI(한국전자통신연구원), 한국화학연구원, 한국에너지기술원
- GIST(광주과학기술원), UNIST(울산과학기술원), DGIST(대구경북과학기술원)

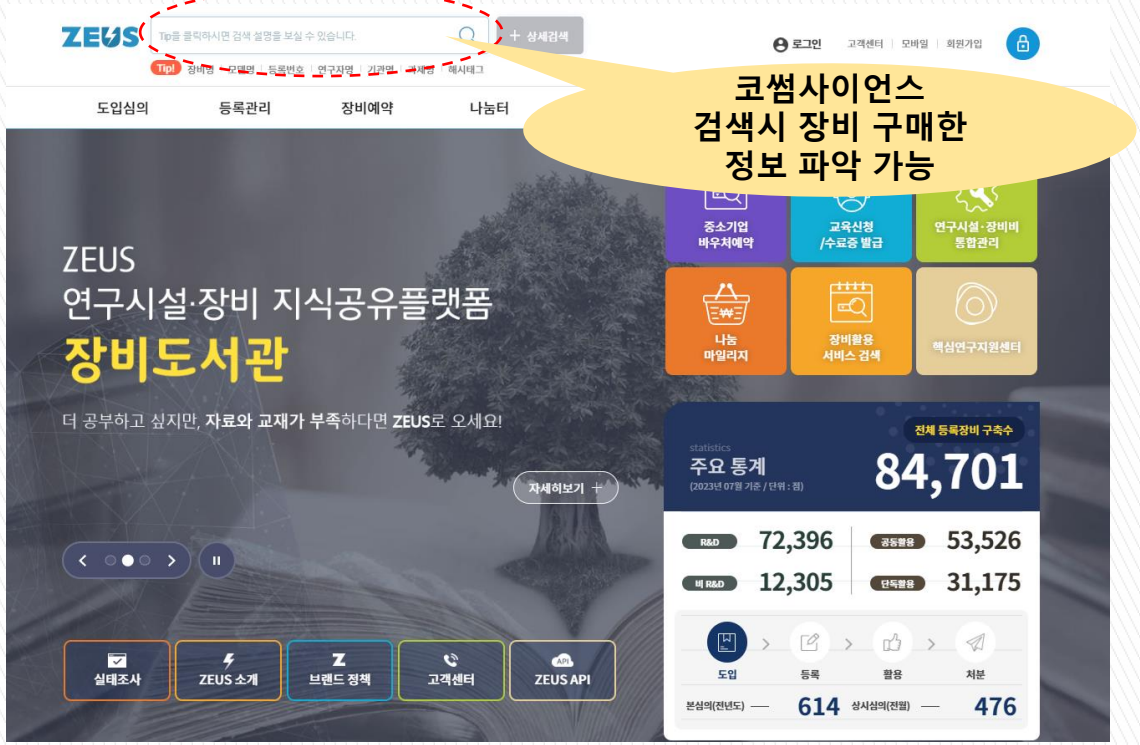
국내대학 연구소

- 성균관대학교, 충남대학교, 연세대학교, 서울대학교, 고려대학교, 부산대학교

❖ 납품 장비 : u-Fab. System, u-Lab. System

13. ZEUS(장비 활용 종합 포털)

❖ **ZEUS (장비 활용 종합 포털)** https://www.zeus.go.kr/main

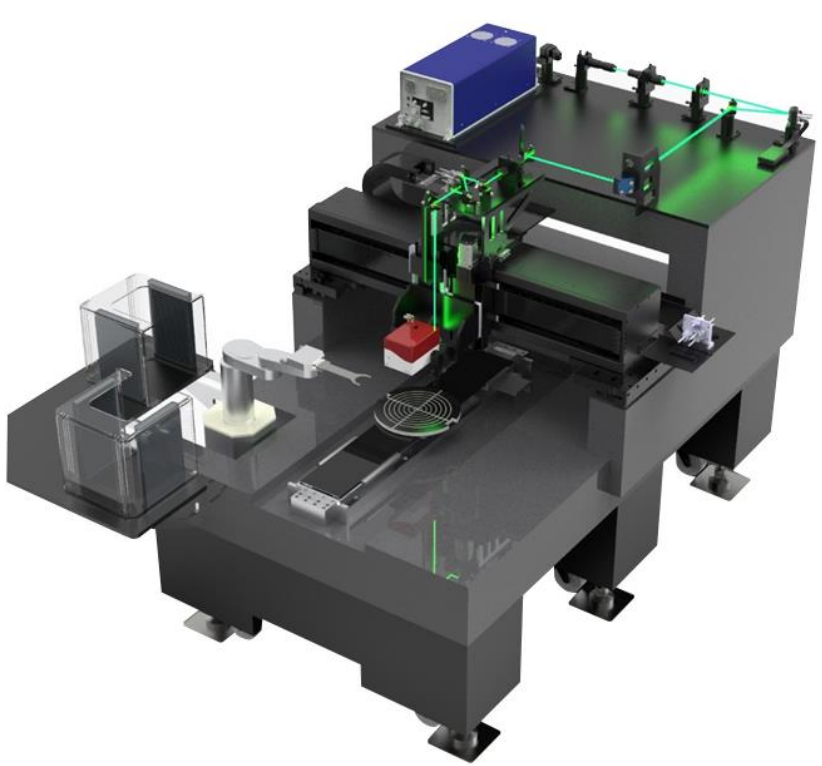


9. μ-Fab-I (Using SLM & Axicon Lens)-

μ-Fab-I
(Using SLM & Axicon Lens)

◆ Specification

Laser Pulse Duration	NANO / PICO / FEMTO
Wavelength	355nm(UV)/ 532nm(Green)/ 1064nm(IR) 중 1 종류 적용
Operating Mode	IFOV
Traveling range	300~600 mm (X) x 300~600 mm (Y)
Working Type	Patterning / Scribing / Cutting / Drilling
Application	Transparent material (Quartz, Sapphire, Glass wafer 등)
Working Dimension	300~600mn(X) x 300~600mm(Y) x 50mm(Z)



* 핵심 기술 :

1) SLM과 Bessel beam을 적용, Maskless 가공 가능

2) 멀티 beam을 통한 작업시간 절약 가능