

***Hard Material
Thinning Process Development
and
Full Auto Thinning Machine (SGL6)***

Semiconductor Process Development Dept.

Okamoto Corporation

19th September 2013

Confidential

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About OKAMOTO [CORPORATE PROFILE]



- **Foundation** : **June 1935**
- **President** : **Jitsuo Nishimoto**
- **Capital** : **49 million USD**
- **Sales Turnover** : **200 million USD (March 2013)**
- **Employees** : **1,700 (All Group)**



About OKAMOTO [BUSINESS LOCATIONS]

Overseas market

Okamoto Machine Tool Europe GmbH
Frankfurt



Okamoto (Thai) Company Ltd.
Ayudhaya



Annaka Factory, Japan



**Okamoto Machine Tool
(Shanghai / Shenzhen) Office**
Shanghai



Okamoto Corporation
IL Chicago

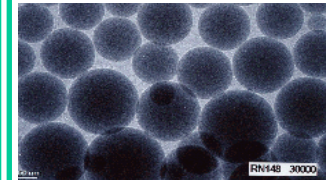
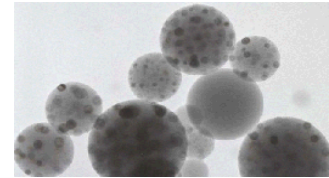


Okamoto (Singapore) Pte. Ltd.
WoodLand



Okamoto Corporation
CA / Santa Clara & Santa Fe Springs

About OKAMOTO [ACTIVITIES]



Overall solution for Total Abrasive Process

Fixed abrasive

Loose (Isolated) abrasive

Machine tool

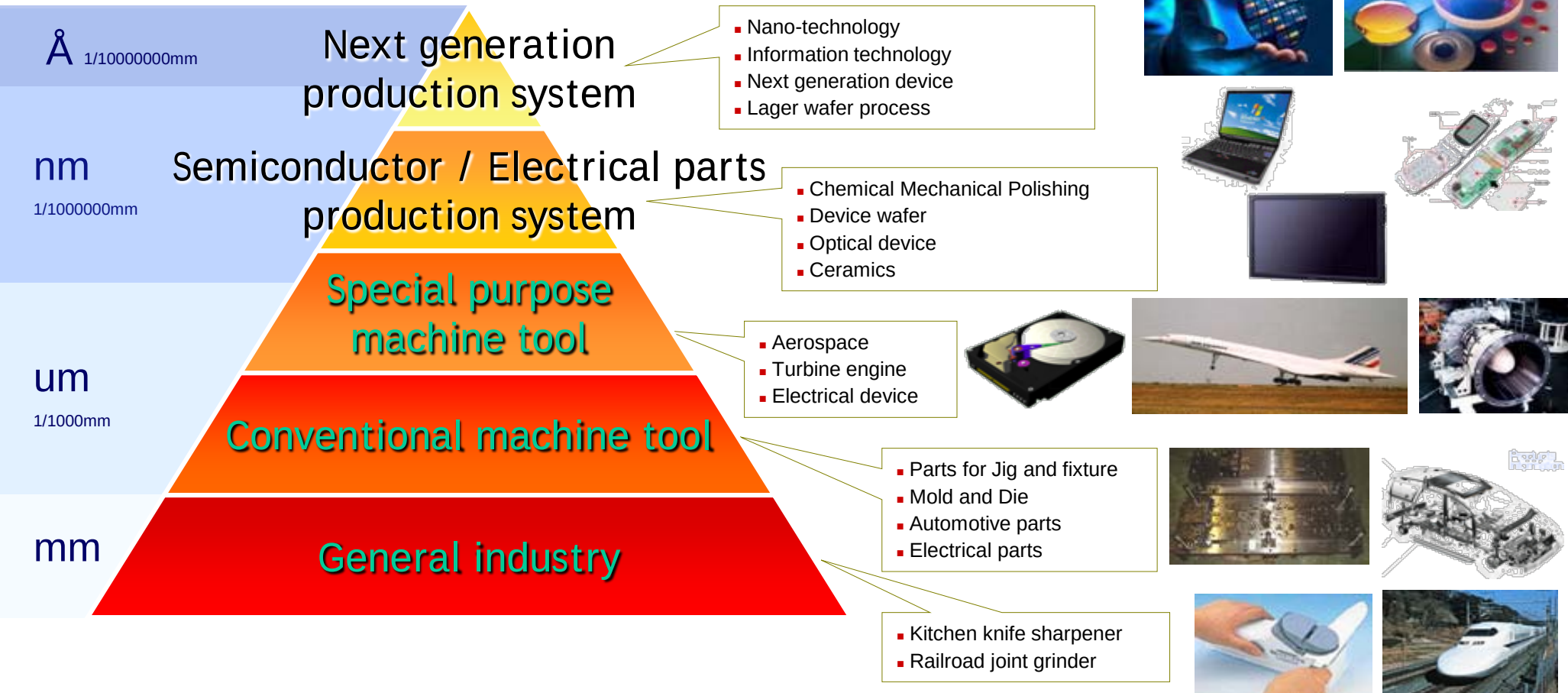
**Semiconductor
system**

**Special purpose
system**

About OKAMOTO [ACTIVITIES]

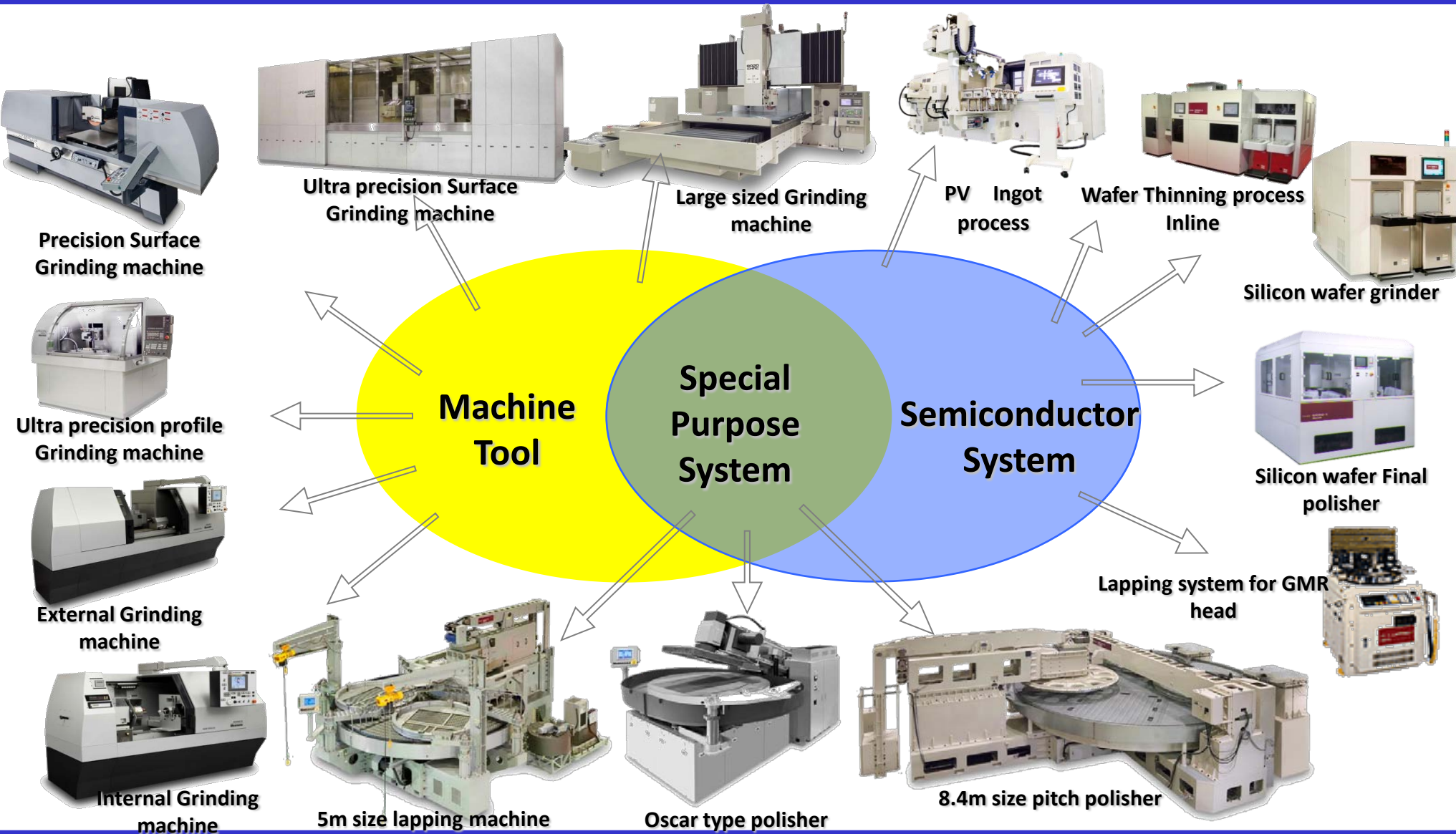
The only manufacturer in the world supplying overall solution for total abrasive process

[Fixed abrasive and Isolated abrasive]



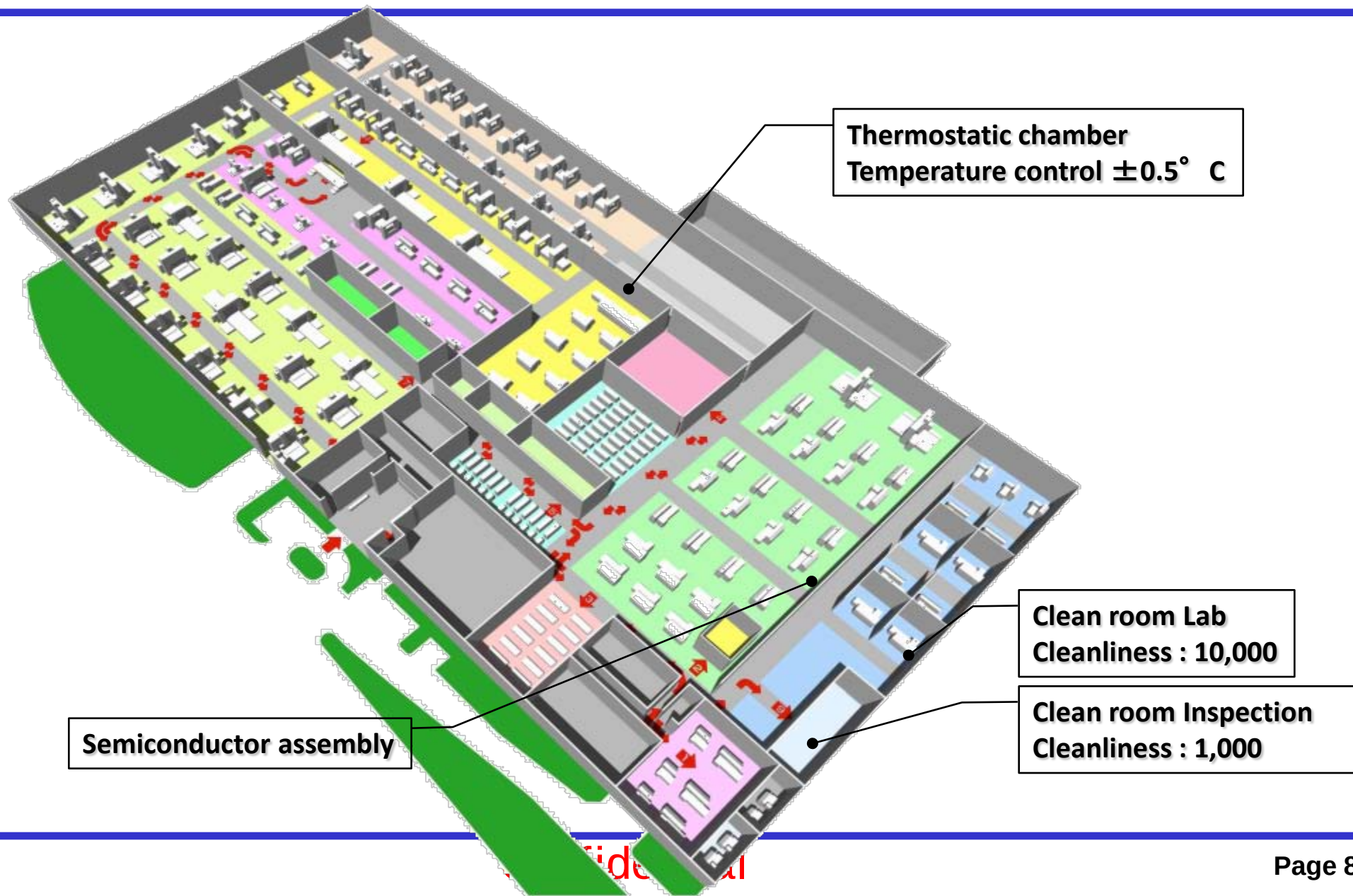
System Lineup

[Overall solution for Total Abrasive Process]



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Annaka Factory



Established independent temperature control area : $\pm 0.5^{\circ}\text{C}$



Assembly



Final Process



Clean Room

Clean room for semi-conductor completed in November 2005

Measurement
room



Test grinding
Booth

Clean level : class 1000



Thai Plant

Total integrated production system From casting production to assembly process

■ Foundation : Dec. 1 9 8 7

Start to produce casting : June
9 9 0

Extension factory : October 1 9 9
6

I S O 9 0 0 1 : November 2004

I S O 1 4 0 0 1 : 2005

■ Employee : 7 3 0

Machine/assembly 3 5 0
Casting

3 5 0

Office

3 0



Thai Plant

Extension new assembly line
produce 150 units per m



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Singapore Plant

■ Foundation : December 1973

First extension : June 1981 (8,250 m²)

Second extension : march 1986 (12,800 m²)

Third extension : September 1991 (250 m²)

ISO 9002 : 1994

■ Employee : 230

Machine / assembly

5

Office



Singapore Plant

Assembly room and semi-conductor clean room

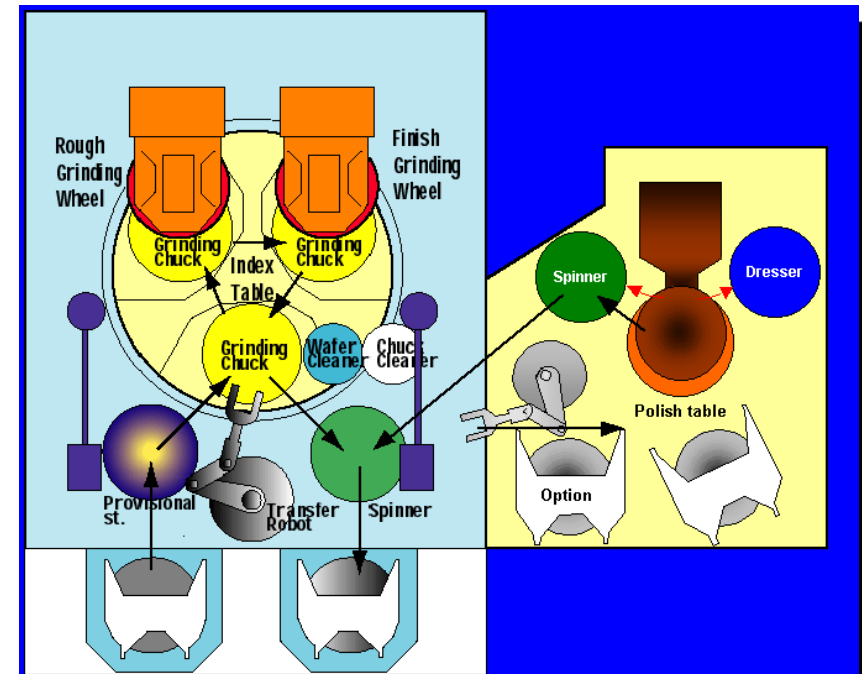
Machine tools
Assembly room



Semi-conductor room



Full Auto BG GNX-200B

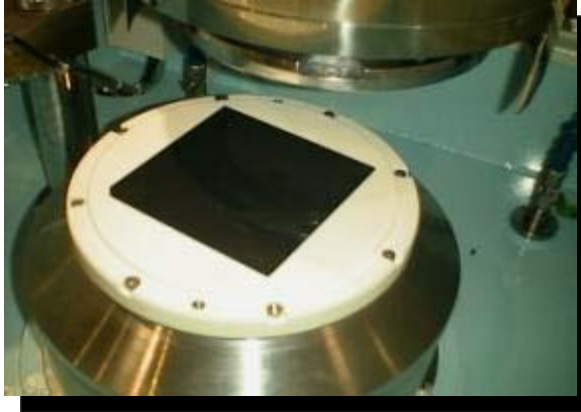


Full Auto BG GNX-200B



- TTV $\leq 1.5 \text{ um}$
- Thickness Variation (WTW) $\pm 1 \text{ um}$
- Roughness (#2000)
 - $\leq R_{\text{max}} 0.10 \text{ um}$
 - $\leq R_a 0.01 \text{ um}$
- Depth of damage
 - #325 15 um
 - #600 8 um
 - #2000 1.4 um
- Throughput 35w/hr (420um/#325 20um/#2000)
- MTBF 560hr MTTR 7.5hr Up Time 98.86%
- Breakage rate 40ppm

Custom Designed Chucks



Square chuck



Round chuck



Special chuck

**Solution for
Ceramics/Glass/AlTiC
Other brittle material**

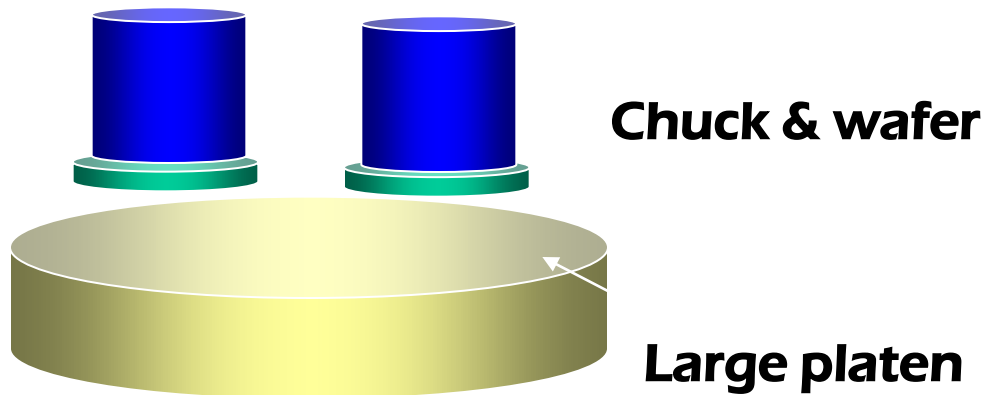


AlTiC Grinding



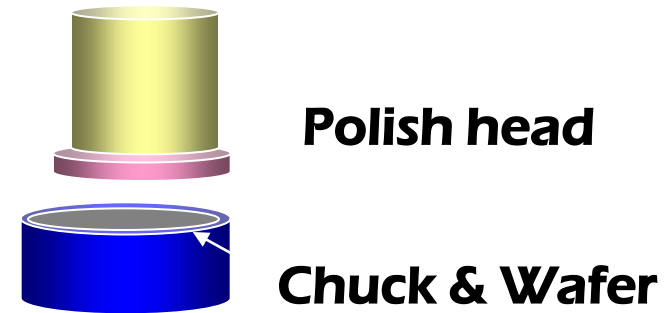
- **Very Hard material**
- **High rigidity machine construction**
- **High power spindle motor**
- **In-Situ wheel cleaning system**
- **In-Situ Dressing system (Continuous dressing)**
- **Suitable Grinding wheel**

CMP Technology



Large platen method
(PNX322, SPP-600, TSV300)

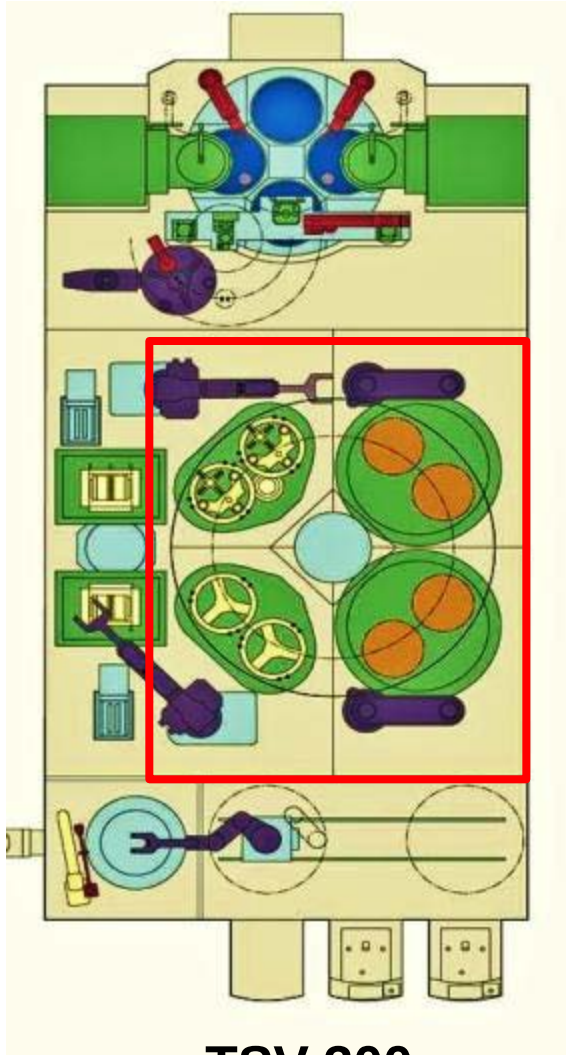
◆ **For big removal amount**



Scan polish method
(GDM300)

◆ **For small removal amount**

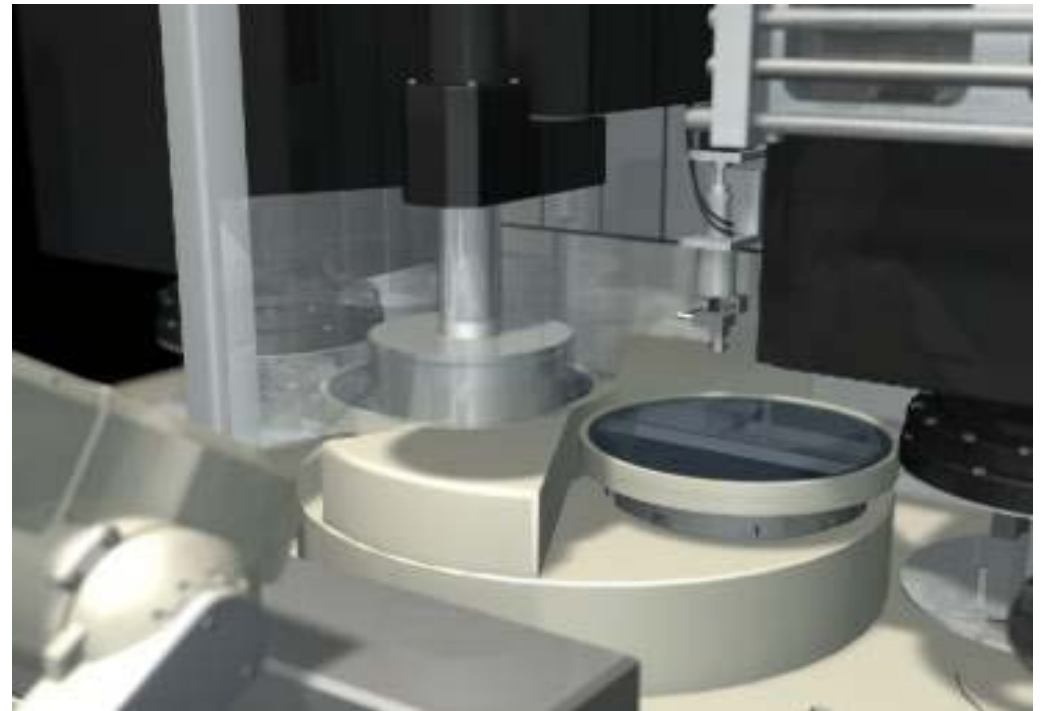
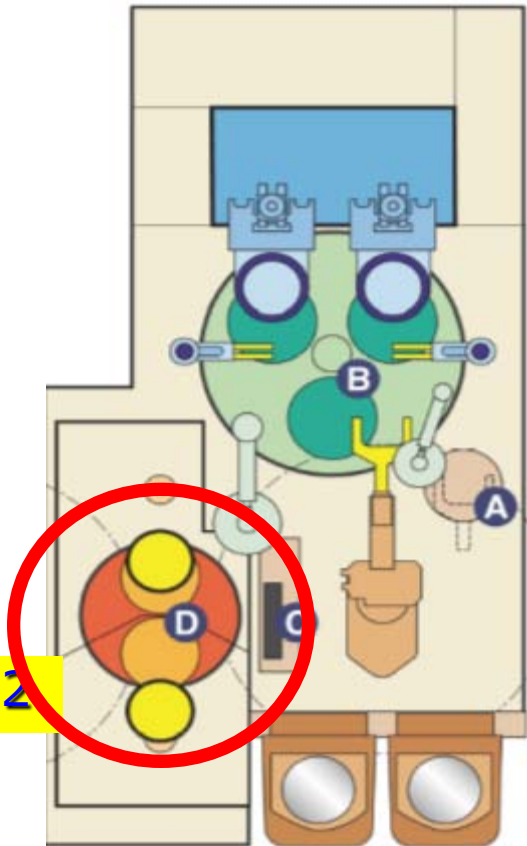
CMP Technology -1



TSV 300

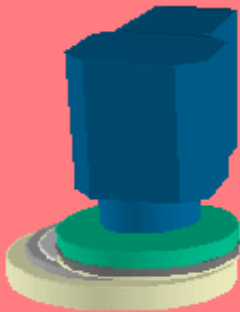


CMP Technology -2



OKAMOTO achieve high throughput by 2 polish stage & head

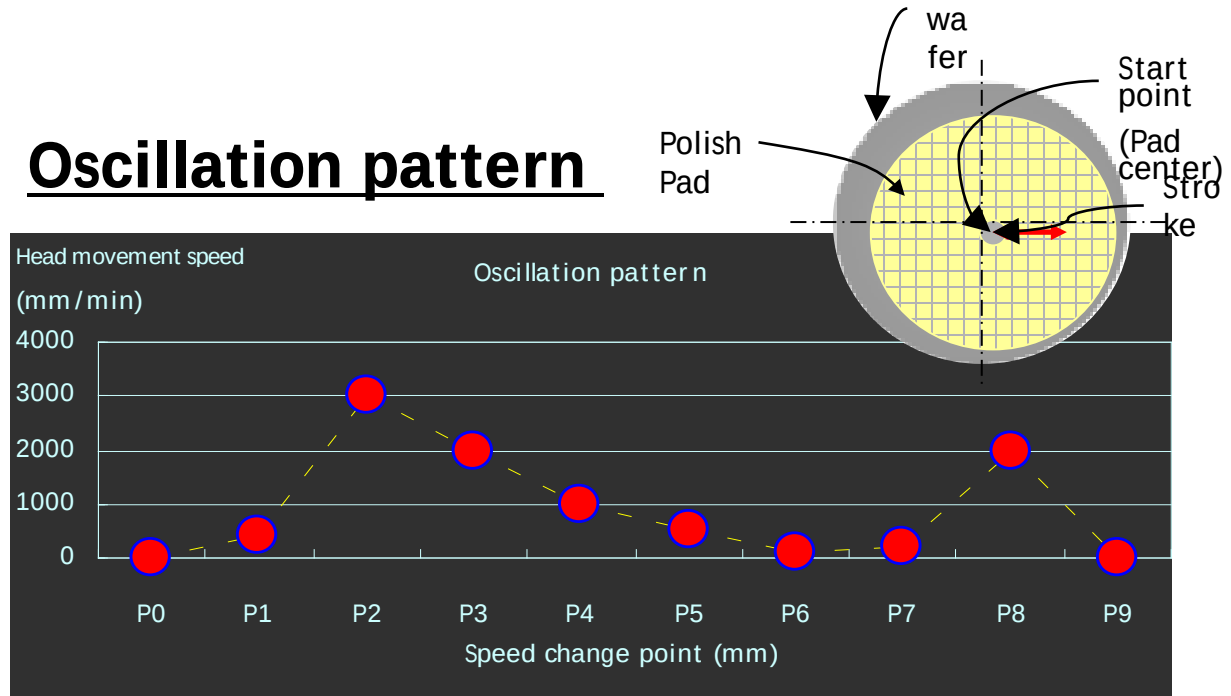
SCAN CMP SYSTEM



Scanning polish

Conventional polishing [Fixed speed]

Oscillation pattern



Lapping System



Wafer : 4 inch Sapphire wafer
Thickness : 170um to 150um
Feed rate : 1um/min
Slurry : 3um diamond

AlTiC Low Bar Lapping

	Ry			Ra			:um
工程	Cen	Mid	Out	Cen	Mid	Out	Ra Max
Lap後	0.1149	0.1430	0.085	0.0056	0.0068	0.0069	0.0069

High-Precision Lapping machine SPP32P



Main specification

Table dia. : 800mm

Lapping head: 2-4

Facing unit

※Table dia. can be changeable
Depend on the request

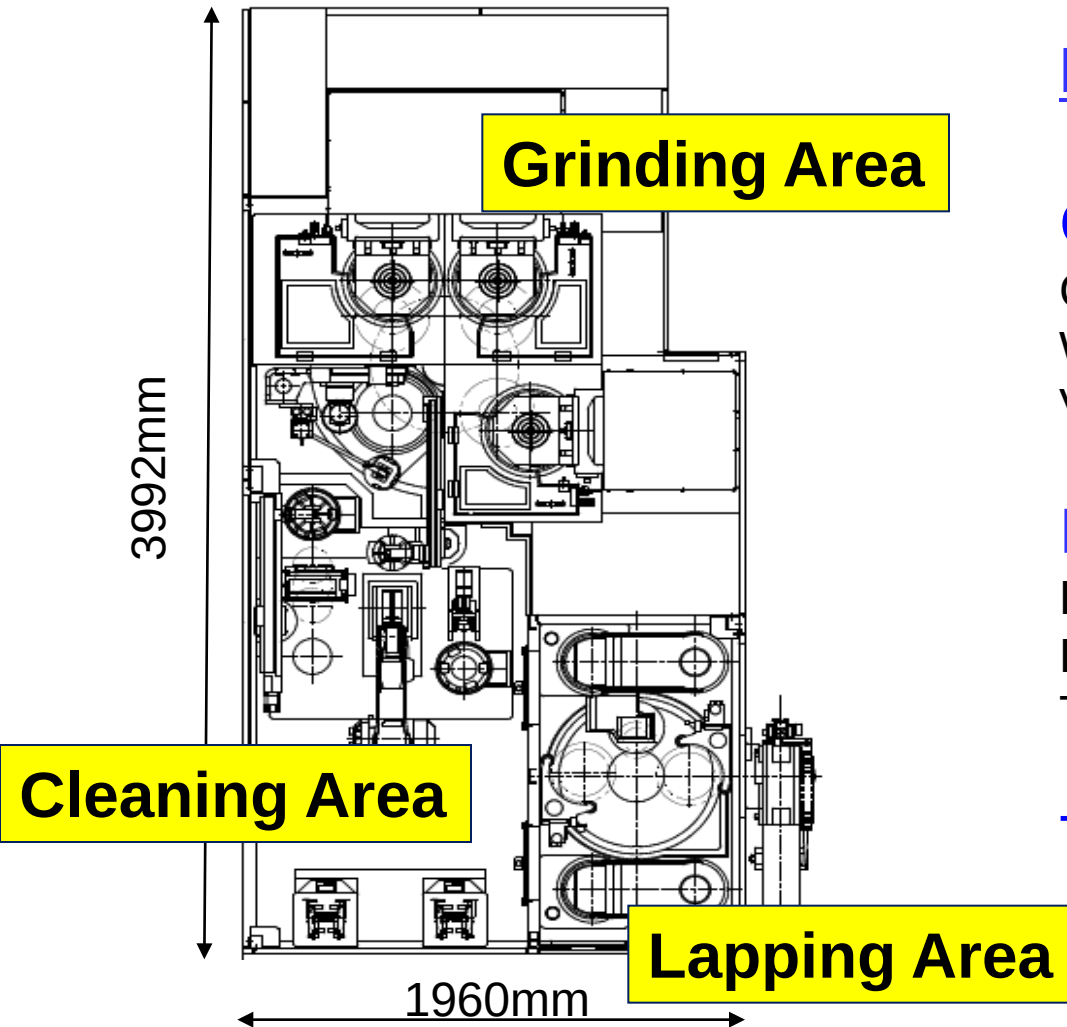
SGL6

Full Auto Hard Material Wafer Grinding & Lapping Machine



**Full Auto Grinding and Lapping (Polishing)
Machine for Compound Semiconductor Wafer
(Sapphire , SiC , GaN , AlTiC)**

SGL6 Machine Layout and Main Spec.



Main Specification

Grinder

Grinding Head	: 3 Head
Wafer Chuck	: 4 Chuck
Vacuum Size	: $\phi 200\text{mm}$

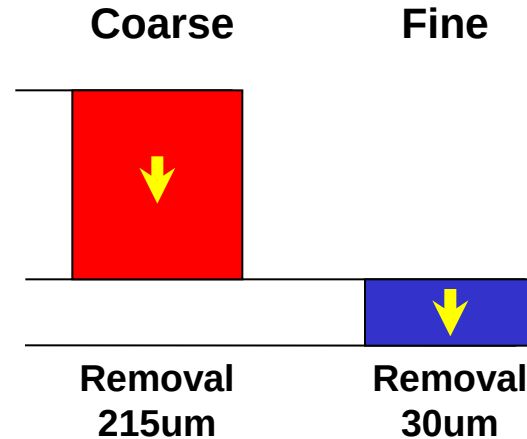
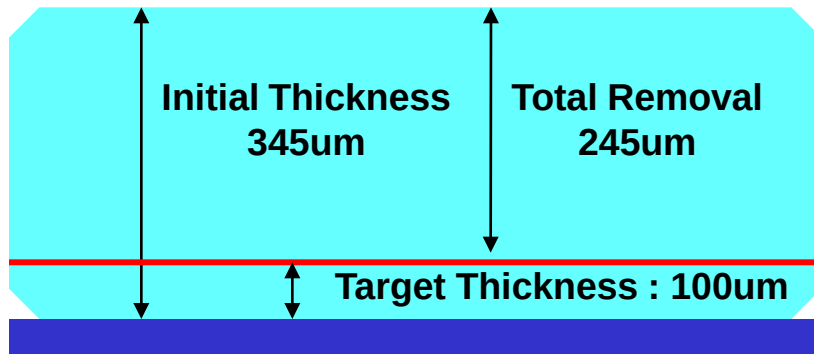
Lapping

Head	: 2 Head
Lap Plate Size	: $\phi 600\text{mm}$
Table Facing	

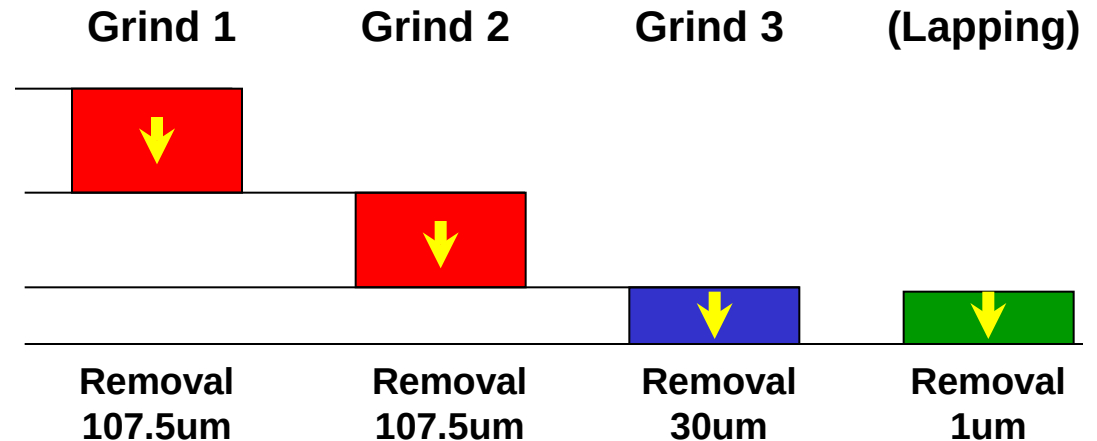
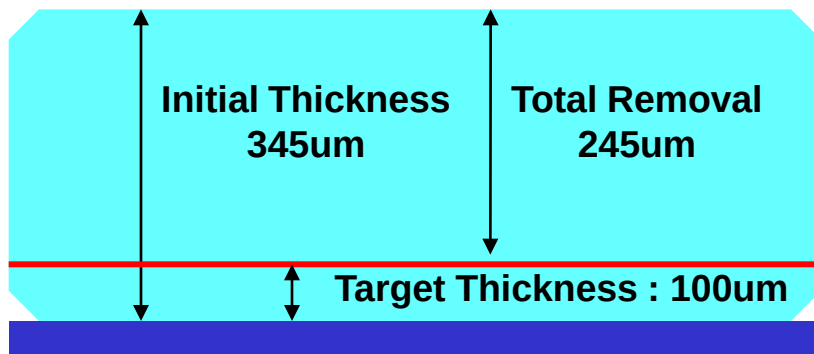
Transfer Robot

Hard Material Thinning Process

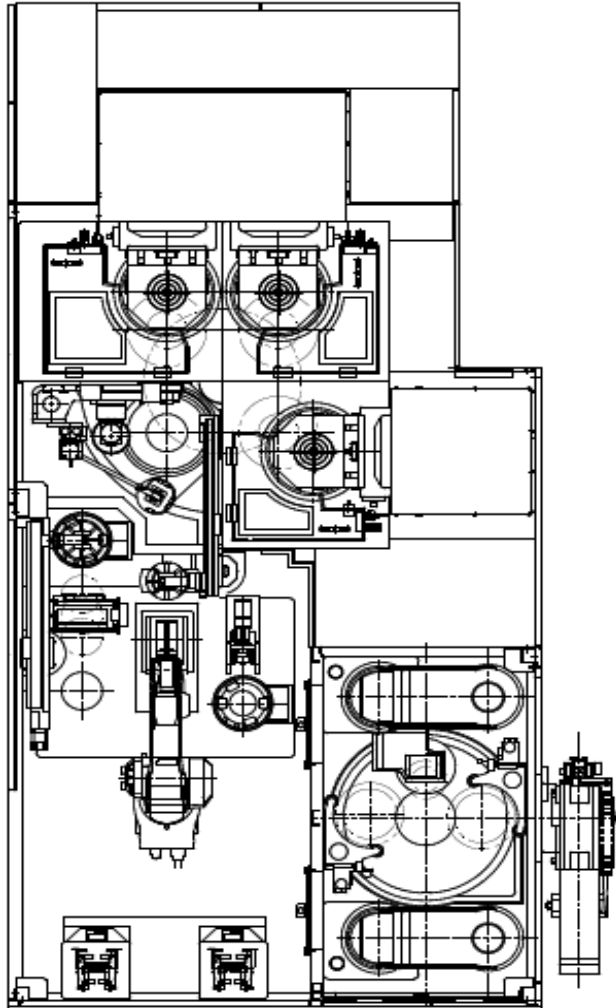
2Step Grinding Process



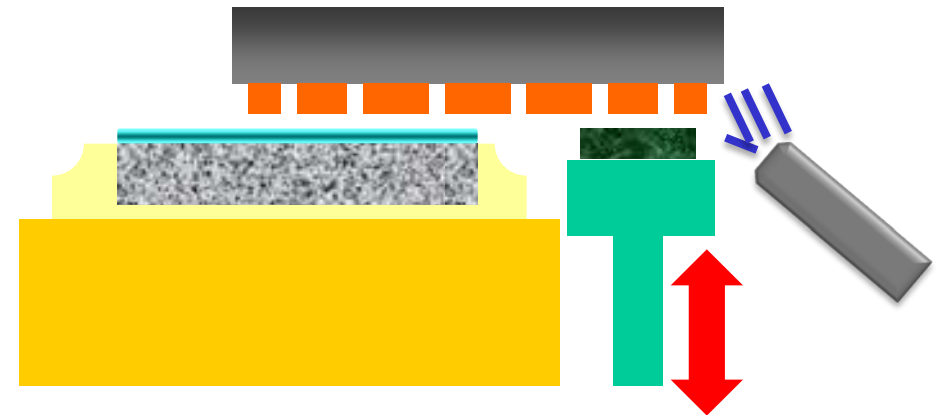
3Step Grinding Process



SGL6 Feature 1

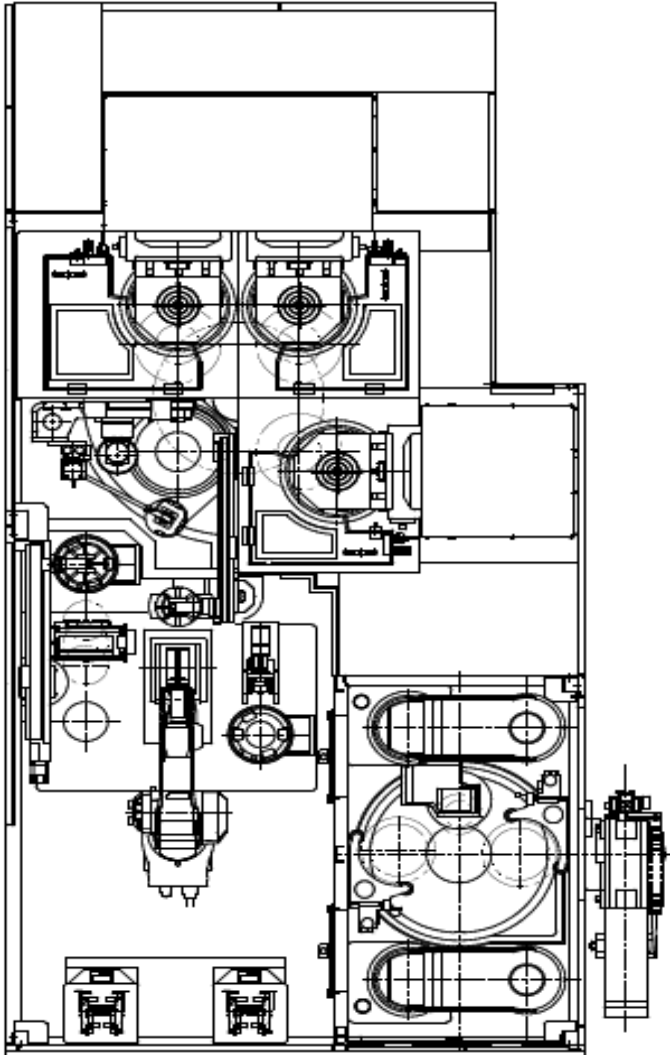


In-situ Dressing & Wheel Cleaning

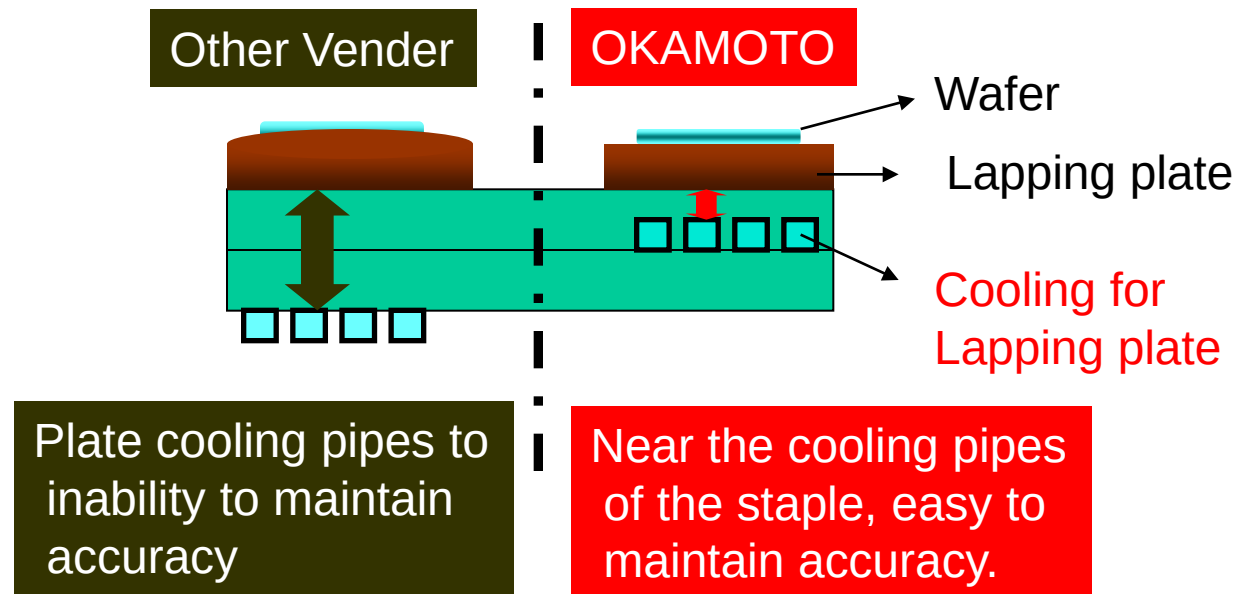


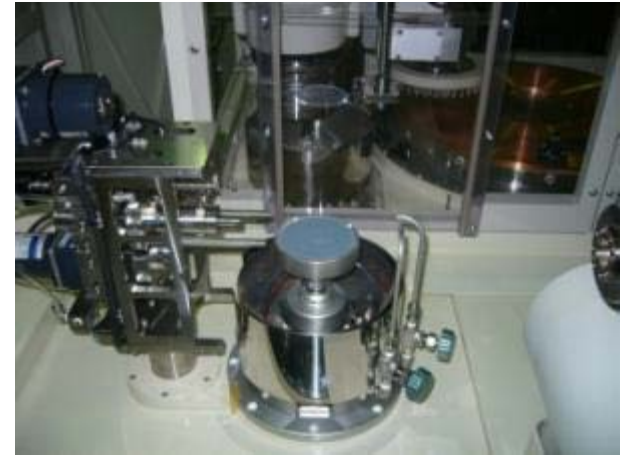
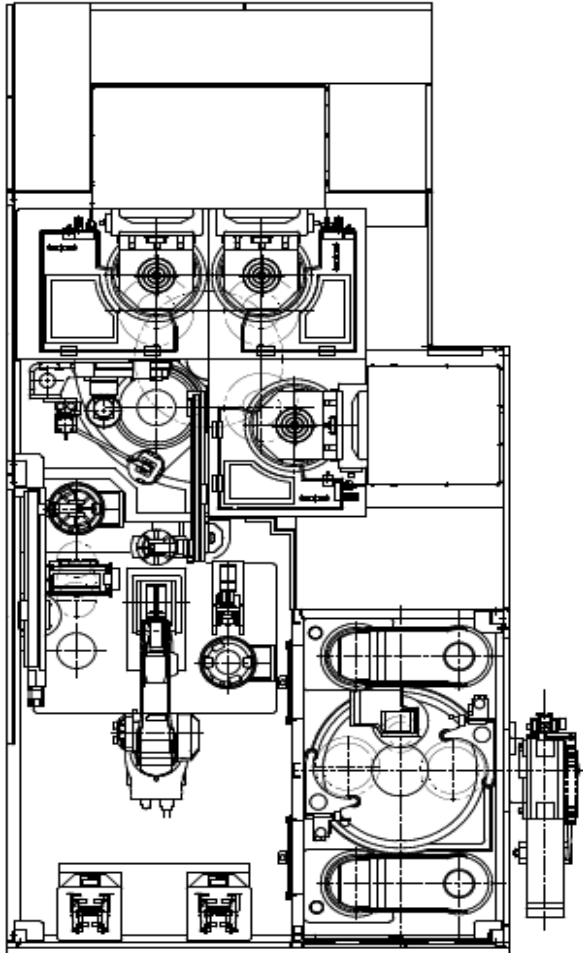
- Device Yield Up
- Wheel Life Up

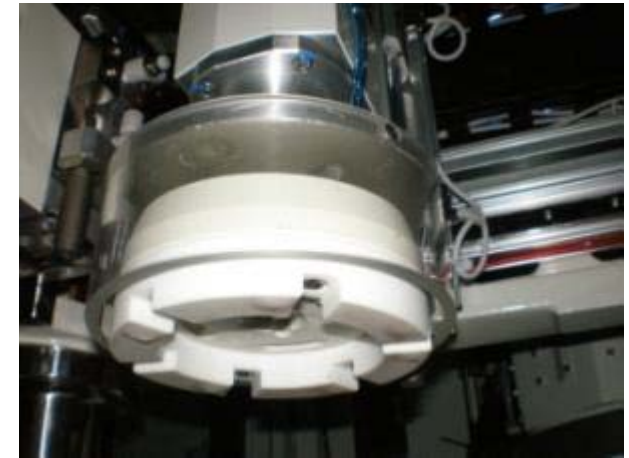
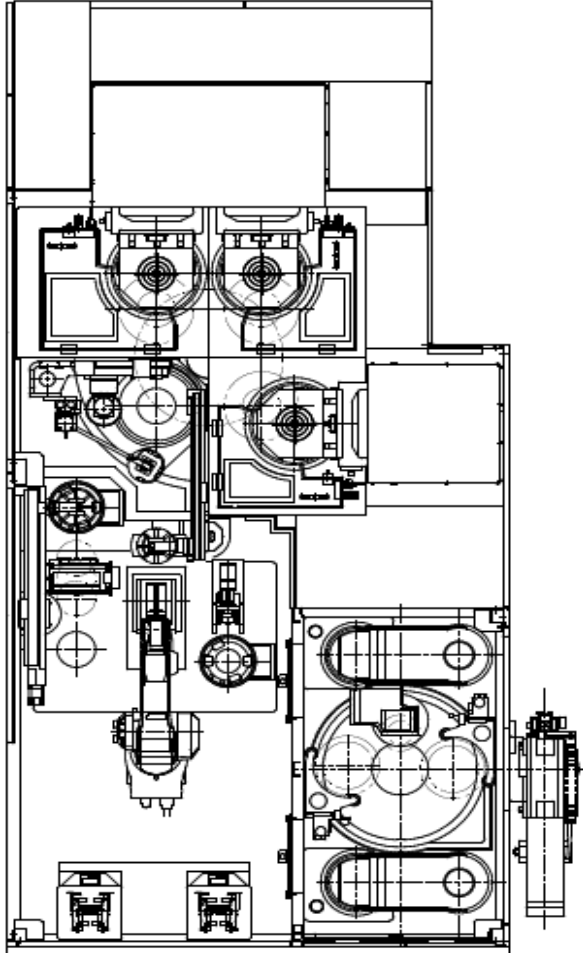
SGL6 Feature 2

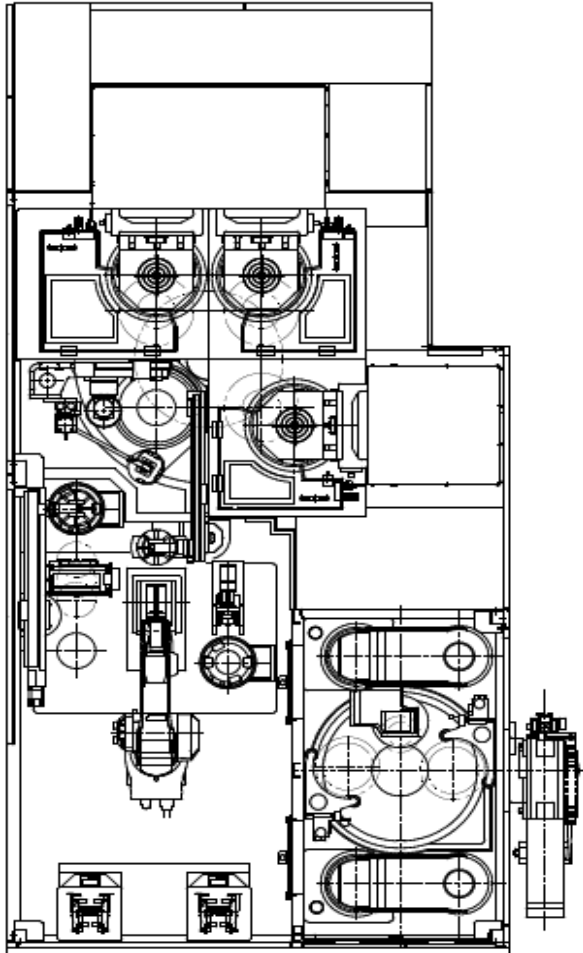


Lapping Plate Mechanism

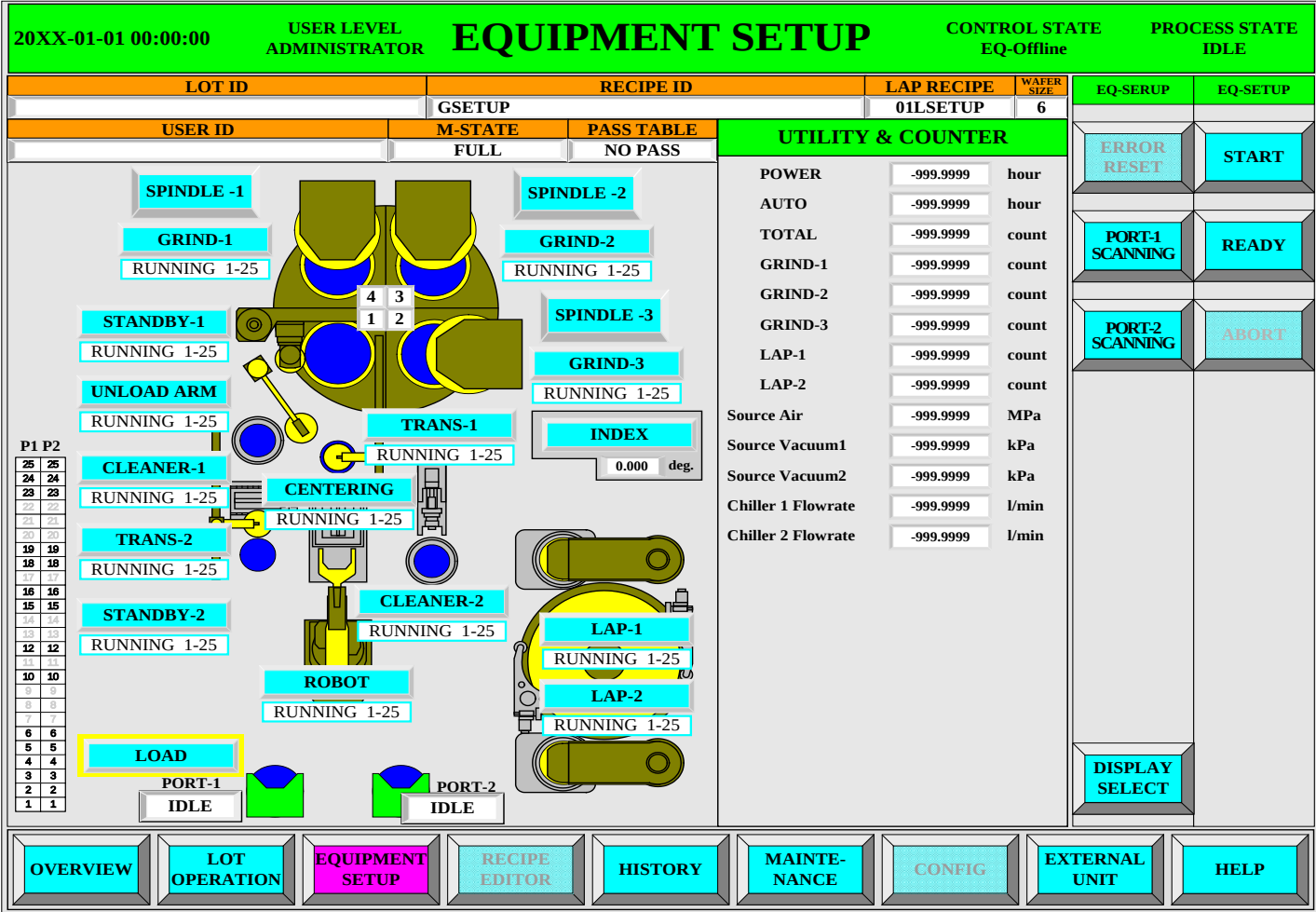






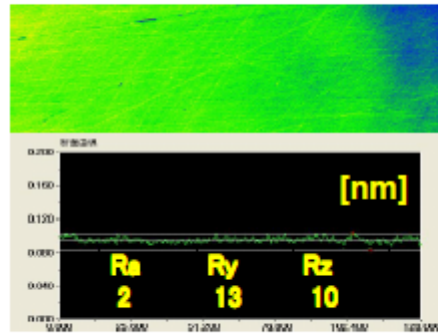


Friendly Operation Touch Panel

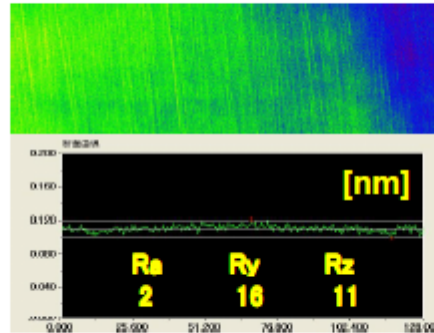


Roughness

After Fine Grinding



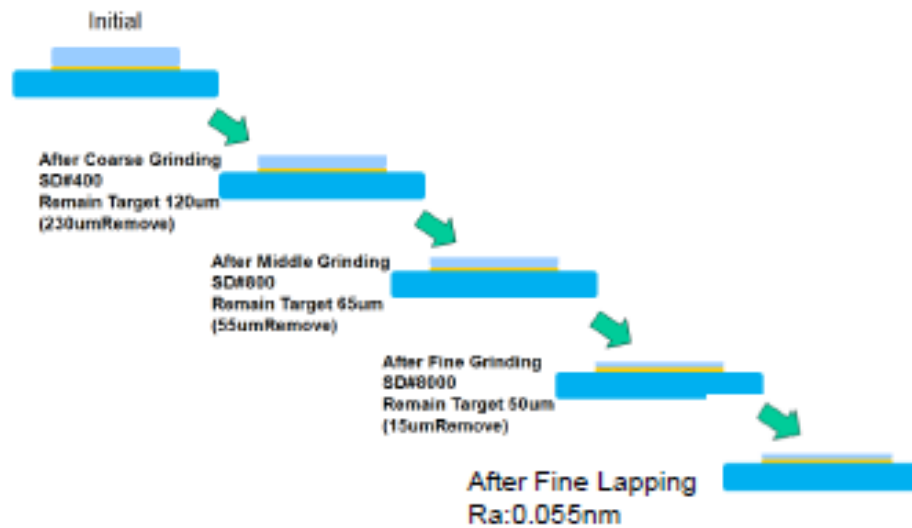
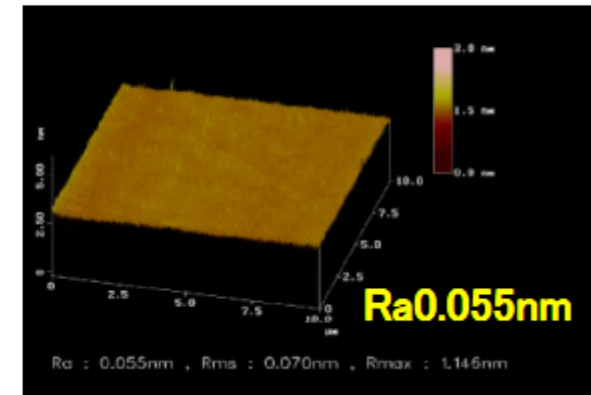
Wafer Center



Wafer Edge

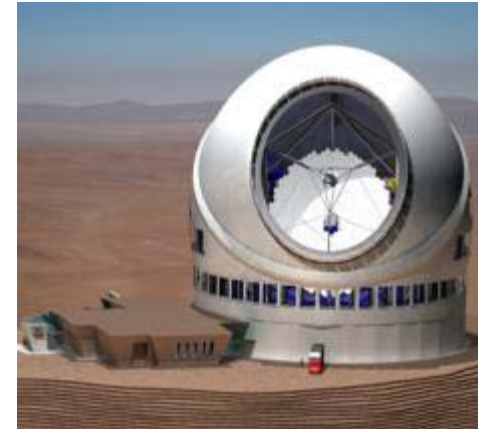


After Fine Lapping



Planarization for Concave Mirror

TMT (Thirty Meter Telescope) starts to construct at Mt. Mauna Kea Hawaii



Material	Thermal expansion coefficient	Consistency (g/cm ³)	Knoop hardness	thermal conductivity (w/ m · k)
Zerodur(Schott)	0.10 x 10 ⁻⁶ /°C	2.53	620	1.43

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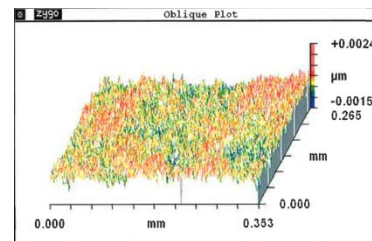
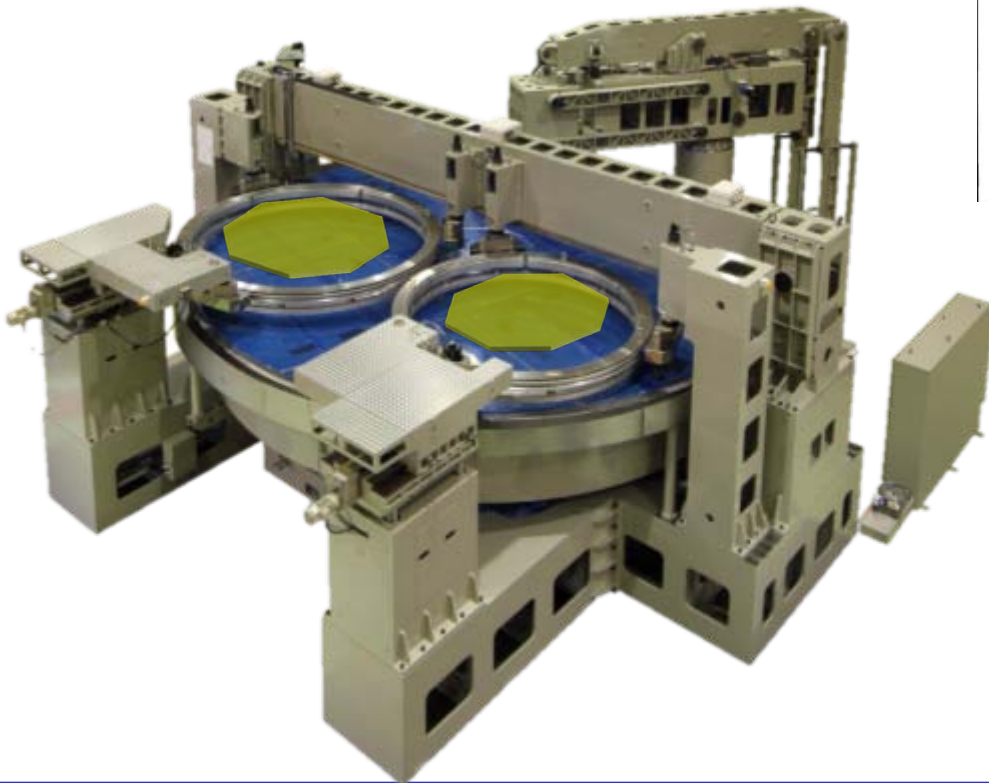
Ultra Planarization by Isolated Abrasive Process

General Requirement

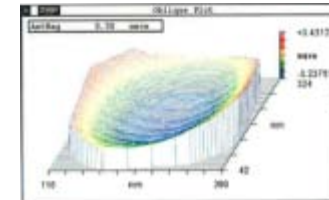
Material : Zerodur

Surface roughness : < 0.8nm

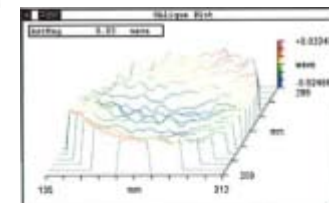
Local flatness : < 100nm/75mm



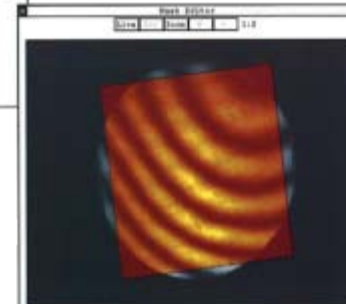
Roughness
0.342nm



Flatness
669nm/φ280mm



Flatness
57nm/φ76.8mm



End.

<http://www.okamoto-sed.com>