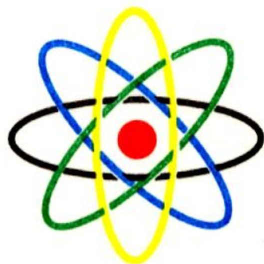
11. July. 2018.

High Speed Laser Scanning Surface Inspection

for Semiconductor･Wafer･MEMS･Thin Film & DISK
Solution of Surface Profile Inspection
by Core System "CSM" / "CSYS" series

Patented No.3810749 Japan



Core System Corporation

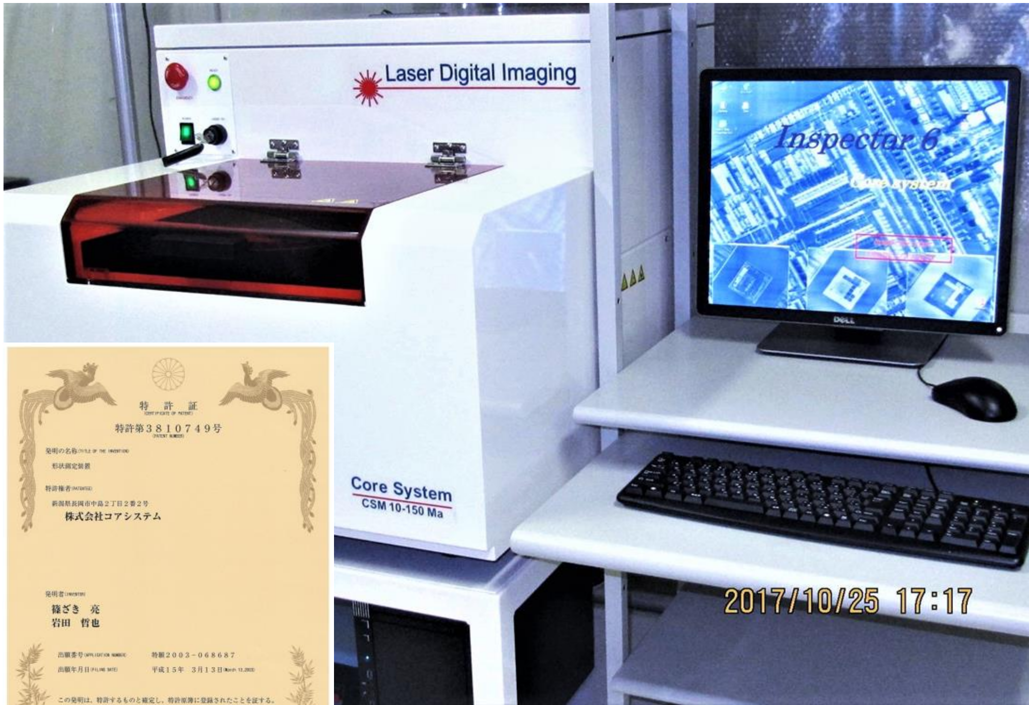
Core System "CSM" / "CSYS" Series

High Speed Laser Scanning Surface Inspection

Applications [Mirror Surface] Si Wafer, CMP /Grinding Surface, Thin Films, Spattered Surface and Resin Coated Surface, Hard Disk, LCD / FPD, Film ★In the case of the surface shape measurement of the transparent object, prevention of back side transmission of the laser beam is necessary.

High Speed Laser Scanning Surface Profiler

"CSM" 4 model:Φ25mm～Φ450mm



特 許 証

特許第3810749号

株式会社コアシステム

中嶋 誠

Patented JAPAN

Model	CSYS 12-450	CSYS 12-300	CSYS 12-200	CSYS 12-100
Optical unit				
Scan width	40mm			
Scan ratio	30Line/sec			
Sampling ratio	1～10MHz(3.9μm)			
Measuring time	20sec / 40x40mm			
	Φ450mm / 6 mionutes	Φ300mm / 4 minutes	Φ200mm / 3 minutes	Φ100mm / 2 minutes
Soft wear				
Data display	3D Surface			
	Line Profile			
Flatness mode	Surface Flatness			
Microwaviness	Filtered Flatness			
Slope mode	Differential calculutus highlights			
Reflection Intensity	Scatter Dencity			
Stage size	500x500mm(Φ450mm)	300x300mm(Φ300mm)	200x200mm(Φ200mm)	100x100mm(Φ100mm)
X axis	±250mm (0.010mm pich)	±150mm (0.010mm pich)	±100mm (0.010mm pich)	±50mm (0.002mm pich)
Y axis	±250mm (0.010mm pich)	±150mm (0.010mm pich)	±100mm (0.010mm pich)	±50mm (0.002mm pich)
Θ axis	360°(0.0025°pich)	360°(0.0025°pich)	360°(0.0025°pich)	360°(0.0025°pich)
poewr supply	AC100V±15% / 15A			
Weight	110kg	80kg	50kg	50kg
Choice Laser Light source	1. Violet Laser Diode		2.Read Laser Diode	
	①Wave length: 405nm		①Wave length: 655nm	
	②Powe: 20mW		②Powe: 30mW	
	③Class: 3b		③Class: 3b	
	④Beem spot size: Φ10μm		④Beem spot size: Φ25μm	
	⑤Examination angle: ±0.2°		⑤Examination angle: ±2°	
	⑥V sensitivity: 0.1nm(1Å)		⑥V sensitivity: 1nm(10Å)	

Core System "CSM" Patent Registered Technology

Patent 3810749th registration [Shape measuring instrument] : June 2, 2006. Japan Patent Office

Principle of Detection

Principle

L

$\Delta(x)$

2θ

l

θ

P

S: $f(x)$

x

Assumption: $\theta \ll 1$

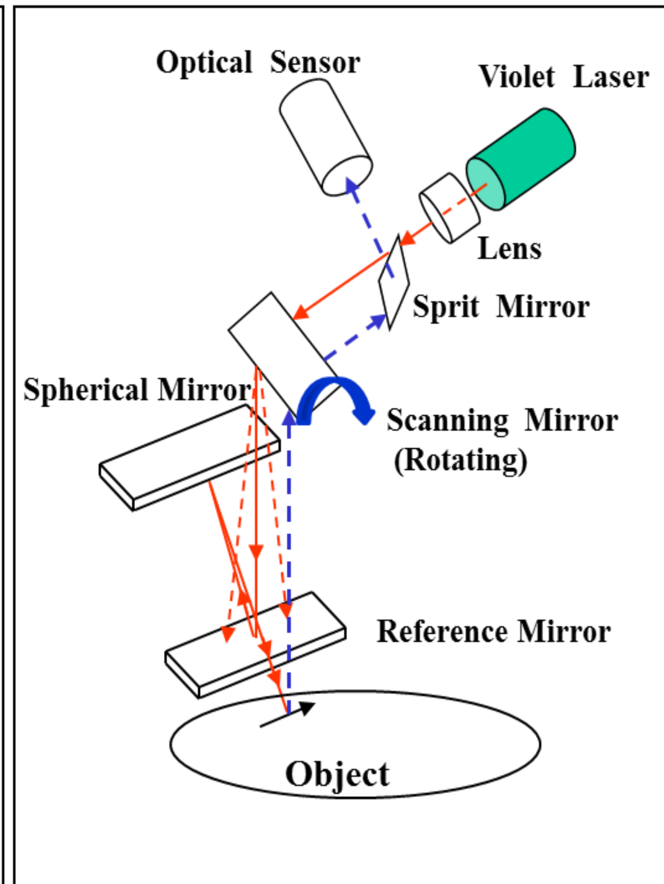
$$\frac{df(x)}{dx} = \tan\theta \approx \theta \quad \text{at point } \mathbf{P}$$

$$\Delta = 2\theta l$$

$$\alpha \int dx \Delta(x) = \int dx\, \theta(x) = f(x)$$

$$\alpha = 1/(2l)$$

Optical Layout



Applications

- Thin Films, Spattered Surface and Resin Coated Surface
- Silicon Wafer,
- Hard Disk & Glass Disk /Mask,
- FPD
- Metallic Film
- CMP Surface
- Dia Turn Surface,
- Grinding Surface

"Detection principle" The laser is applied to the measurement surface, the angle of the catoptric light changes with the gradient angle of the surface.
Because proportion (gradient angle two times) makes this reflective second of arc angle of dip in the surface, when angle displacement (minute angle 2 θ = ⊿ (x)) is measured, derivative value in a sample face is obtained. The thing by which that's integrated gives us the surface form.
"Of the wide measuring range, sensitive surface shape measurement is possible by a short time."

Concept of Development Core System "CSM/CSYS" Surface Inspection

Area by Measurement

□1m □100mm □10mm □1mm □100μm □10μm □1μm

Resolution by Hight (Z)

1mm 100μm 10μm 1μm 100nm 10nm 1nm 1Å

Naked eye

Contact finger

Spectro interferometer

Resolution necessary to critic evaluation of Wafer surface

Concept of Development "CSYS" by Core System

Phase-shift interferomertry

Laser microscope

SEM

Target: resolution as AFM, wide area surface, measuring a short time

AFM

1000000 10000 100 1 1/100 1/10,000 1/1,000,000

The conventional measuring instrument and inspection machine (AFM, SEM, Phase-shift Interferomertry, etc.) setting detectivity of the height strong, and the range that measurement area becomes small.

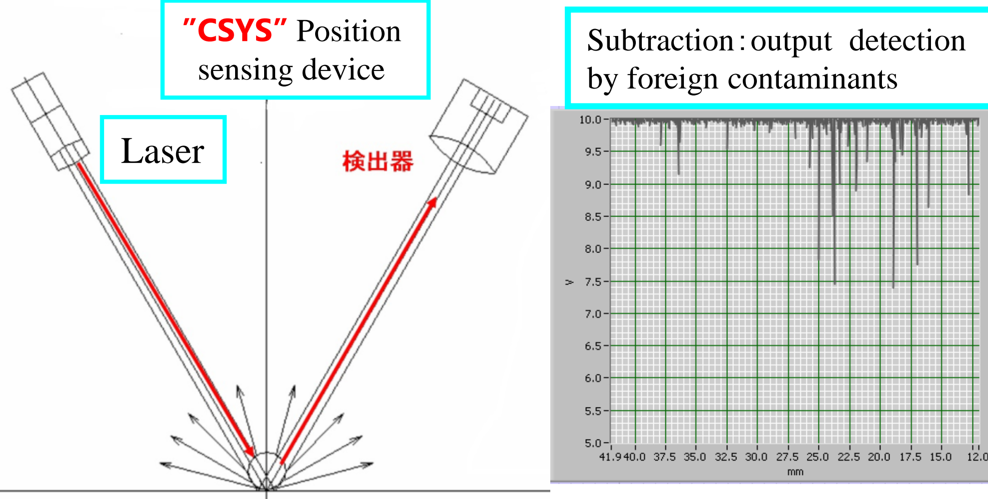
The core system "CSM/CSYS" the development concept of the examination for surface shape machine can measure measurement subject of big surface area at high detectivity exactly at short time.

and operate it fast and make the tester which can display right minute digital image data.

The surface defect being related with the change of the height of the surface shape function

Comparison with Detection of Particles
Others Vs Core System "CSM/CSYS"

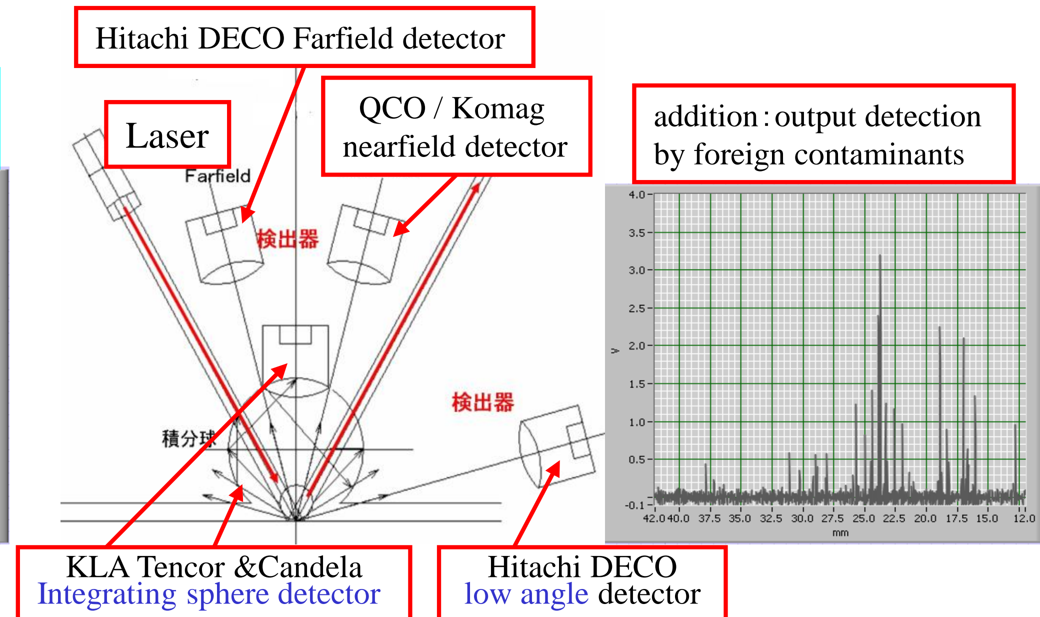
Core System "CSM/CSYS"
Light field
Newest Optical method



Accurately core system "CSM/CSYS" method
not affected by surface shape of the particle
detect absorbed reflection by the surface shape of the particle

Core System "CSM" : Reflection in Directly
Simple is best

Others Dark field
Conventional method



Big risk Others Scattering reflection method
detection particle size error
by the surface shape of the particle

Others : Pick up Scattering Reflection Complication

Wafer Surface Inspection by Core System "CSM/CSYS"

CSM04 Imaging Scope By Core System

view reset

Exit

Home | Exchange | Move stage

System | Paint/color | Inspection

delete dust

Repaint

Filter caution 2

Analysis indication setting

Auto scale | 100

Load data

Slope

Reload center

normal

XYprojection

Read position

Clear 1;1 end

pass

Reject edge 5 mm

Lower Cut Upper Cut 2 0.5 mm

Colors paret Span 100.00

-2000.0 -20.0 20.0 2000.0

X-axis Profile theta Position 320.000

Y-axis Profile r Position -50.4

C:¥data¥mimasu11-05-10¥no slot1.d3c

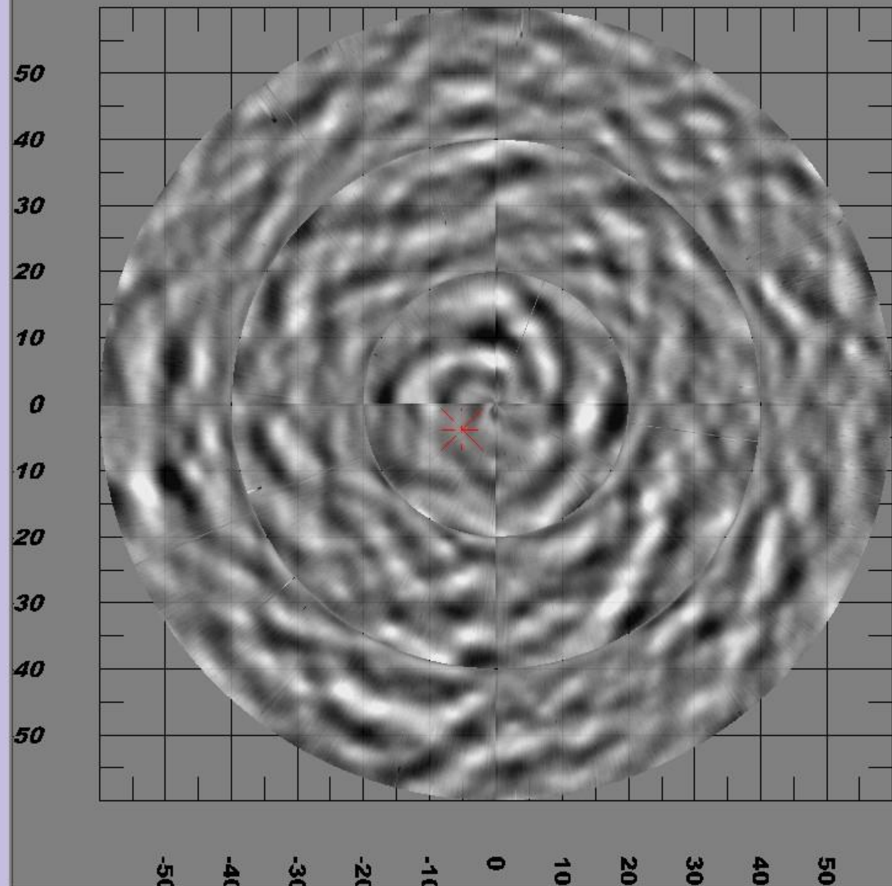
SAVE SCREEN

slope mode/ filter pass/ color span-20.00 to 20.00uRad

Back side Grinding process for Thinning and CMP Sure face inspection by Core System “CSM/CSYS”

Core System

Height (Z) detectivity) : 0.1nm (1Å)



.d3r wafer150,H 232,R 60, span 20, 3 step, 1s.p 0.4, x-10, 2s.p 0.2, x-30, 3s.p 0.1333 x-50,frequency 500KHz, sampling 0.0757, color-50,+50,

surface mode/ filter low cut/ color span-50.00 to 50.00nm

SAVE SCREEN

Exit

Home | Exchange | Move stage

System | Paint/color | Inspection | delete dust

Repaint

Filter caution

Auto scale | radius 2 | 60

Load data

Integral F

signal invert normal

Reload center

XYprojection

reject edge

Read position

Clear

Lowcut

Lower Cut Upper Cut

10000 | 1000 | um

Colors paret | Span | 1000.00

-2000 | -50.00 | 50.00 | 20000

X-axis Profile | theta Position | 53.600 | Max | 23.16 | Min | -31.62

0 | -4.39212 | -12.3416

1 | -1.06017 | 11.252

Y-axis Profile | r Position | -6.29

FFT Measurement Si Wafer Surface Micro Waviness

by Core System "CSM/CSYS" (Analyze Area 10x10 mm)

CSM04 Surface microwaviness(FFT) Measurement

RMS(nm)

縦軸平均粗さ

Exit

Move stage

Repaint

Integral

Clear

10x10 W-1.d1s

Filter mm

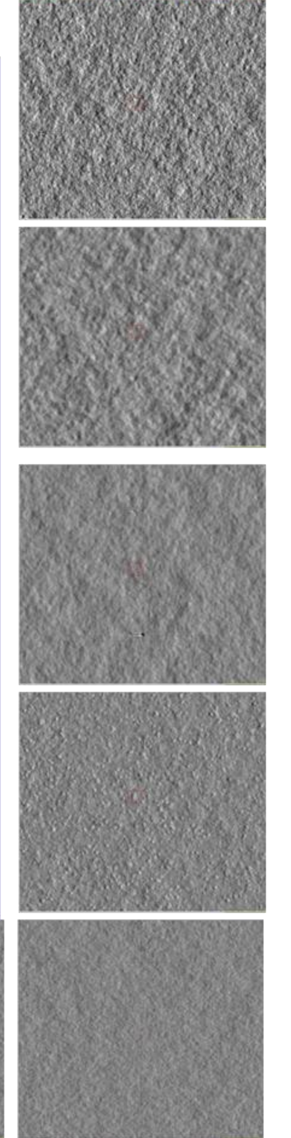
area size 10.02 * 9.99893

横 軸 Filter(mm)

Area ↑
0.8 mm
規格

Area ↑
10 mm

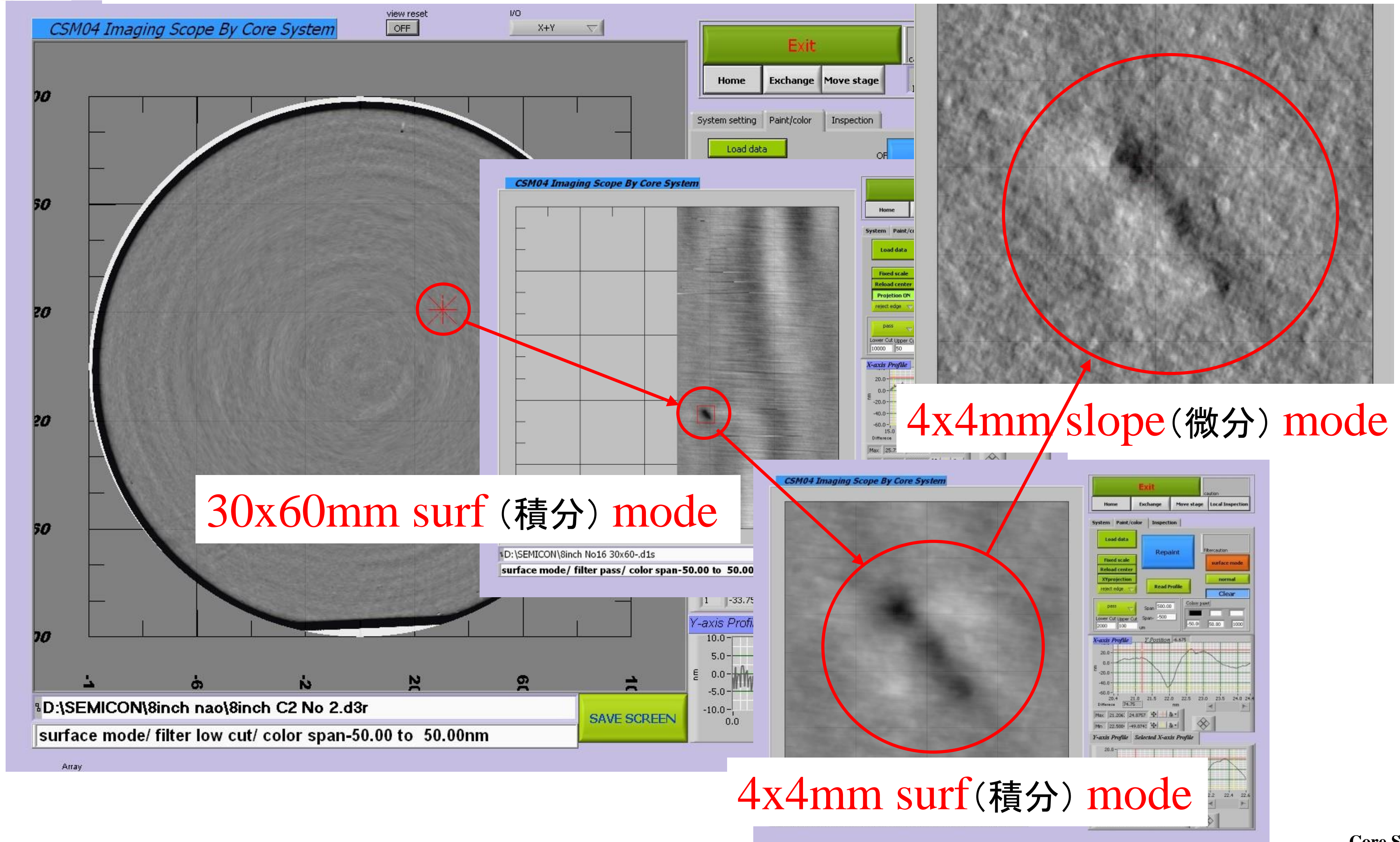
4x4mm slope mode



You will find new discovery, wafer surface have big difference,
by polishing process, equipment and method
related wide range area& small area surface roughness-waviness

Defect of Si Wafer Surface by Core System "CSM/CSYS"

(wafer a commercially available quality goods standard)



Si Wafer Surface Defect by Core System "CSM/CSYS"

(wafer a commercially available quality goods standard)

4x4mm 拡大slope（微分）mode

30x30mm slope（微分）mode

-15.0 -10.0 -5.0 0.0 5.0 10.0 15.0

Max 15 -0.3191C

Min 15 -0.3191C

Difference 0

-9

-15

15 9 3 -3 -9 -15

Y-axis Profile

Selected X-axis Profile

X Position -4.89

4.0 2.0 0.0 -2.0 -4.0

-15.0 -10.0 -5.0 0.0 5.0 10.0 15.0

mm

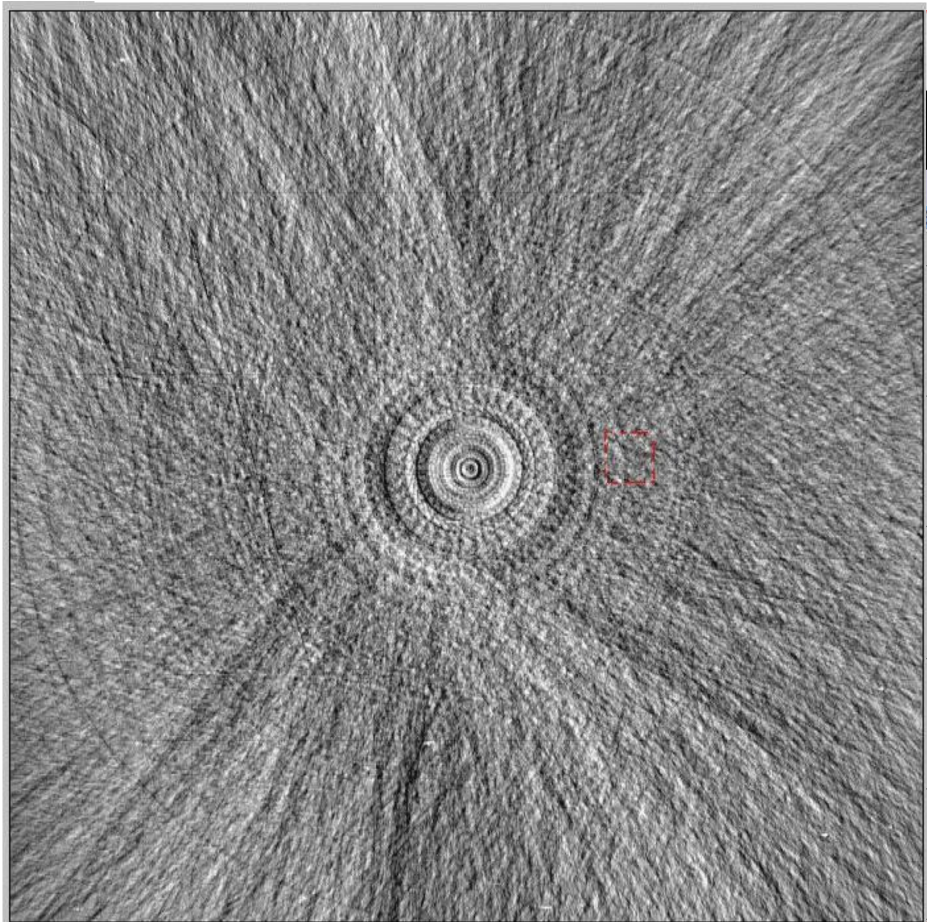
Max 2 3.29 Min -3.99

F:\Data old GX620\iwata\No21 30x30-1.d1s

SAVE SCREEN

slope mode/ filter pass/ color span -5.00 to 5.00V

Si Wafer Mirror Lapping Surface by Core System “CSM/CSYS”
(wafer a commercially available quality goods standard)



Center of Wafer by Core System “CSM”

4x4mm slope mode

30x60mm slope mode

Wafer Ra/RMS inspection by core system "CSM/CSYS"

inspect a fault of the area surface 10-40mm every wavelength

Si Wafer(Epi)Surface Inspection by core system "CSM/CSYS"

Home | Exchange | Move stage | Read local | Offset clear

System | Paint/Color | Inspection | delee dust

Load data | Repaint | Filter caution

Auto scale | radius 2 | 42.03

Reload center | XYprojection | reject edge | Read profile

Slope | normal | Clear

Lowcut | Span | Colors paret

41.96 | 25.17 | 8.39 | -8.39 | 25.17 | -41.96

-41.96 | -25.17 | -8.39 | 8.39 | 25.17

d1r

slope mode/ filter Lowcut/ color span -10.00 to 10.00V

Core System "CSM/CSYS"

15.94 | 13.70 | 11.46 | 9.22 | 6.98 | 4.75

12.51 | 14.75 | 16.99 | 19.23 | 21.47 | 23.71

Academic COLLABORATION 学術論文・共同研究

Paper

[1]Ryo Shinozaki, [3]Osami Sasaki, and [3]Takamasa Suzuki, "Fast scanning method for one-dimensional surface profile measurement by detecting angular deflection of a laser beam," Appl. Opt. 43, 4157-4163 (2004)[Abstract]

Conference

[2]Thet Naing Oo, [2]Yasuyuki Ohta, [2]Norihiko Tanaka, [1]Tetsuya Iwata, [2]Munehiro Kimura and [2]Tadashi Akahane, "Study on surface alignment of liquid crystal multilayers evaporated on photoalignment polyvinylcinnamate film," in the Proceeding of The 5th International Symposium on Eco-Materials Processing & Design (ISEPD 2004), pp20, Nagaoka, Niigata JAPAN, (January 2004) .

[1]Ryo Shinozaki, [3]Osami Sasaki, [3]Takamasa Suzuki, "One dimension surface shape weighing device by angle of luminous flux of laser swinging detection using high-speed scanning method, 28p-R-13", The 51th Spring 2004 Applied Physics Related Union meeting, 24p-R-13, Tokyo (March 2004)

[2]Munehiro Kimura, [1]Tetsuya Iwata and [2]Tadashi Akahane, "Novel surface profiler system for inspection of flat panel display," The 24th International Display Research Confernce (IMID'04), 18.2, Daegu, KOREA, (August 2004).

[2]Thet Naing Oo, [1]Tetsuya Iwata, [2]Munehiro Kimura and [2]Tadashi Akahane, "Investigation of the surface alignment of liquid crystal multilayers evaporated on photoalignment polyimide film," Japanese Liquid Crytal Society discussion panel 2004, PA04, Nagoya, (September 2004).

[1]Ryo Shinozaki, [3]Osami Sasaki, and [3]Takamasa Suzuki, "One-dimensional surface profile measurement with a fast scanning method by detecting angular deflection of a laser beam," in Photonics ASIA, 5633-05, Beijing, China, (November 2004)

[1]Ryo Shinozaki, [3]Osami Sasaki, [3]Takamasa Suzuki, OPC drum substrate surface shape inspection device using laser beam luminous flux scanning method," The 52nd Spring 2005 Applied Physics Related Union meeting, 31p-ZF-15,Saitama (March 2005)

1. Core System Co.Ltd,. 2-2-2 Nakajima, Nagaoka, Niigata 940-0094 Japan
2. Department of Electrical engineering, Nagaoka University of Technoloty, 1603-1tomioka, Nagaoka, Niigata 940-2188, Japan
3. Faculty of Engineering, Niigata University, 8050 Ikarashi 2, Niigata, 950-2181, Japan

Reference

Suzuki, S.; Adachi, K.; Mori, R.; Casey, E. Effect of radial curvature of magnetic media on glide avalanche Magnetics, IEEE Transactions on Volume 41, Issue 2, Feb. 2005 Page(s): 632 - 635

High Speed Laser Scanning Surface Inspection Machine " CSM/CSYS"
Development, Patent, & Delivery record by Core System

No.	Date	Application	Model	Laser source	Function	Q'ty	Customer	note
	Mar.2003.	**Patent Application "Shape measurement device" "CSM (Core System Surface Measurement) method" No.2003-068687. 特許出願**						**Patent Application**
1	Mar.2003.	Copy Drum Surface	CSM 01	Red LD 655nm	Line scan./work fix	1	Fuji Electric -Matsumoto	Sales & Delivery
2	Mar.2004.	DISK-Surface	CSM 02	Red LD 655nm	Raster scan./work turn	1	Komag San Jose CA.USA	Sales & Delivery
3	Oct.2004.	R&D Liquid Crystalline Flat Panel Display	CSM 03	Red LD 655nm	Raster scan./work move	1	Nagaoka University of Technology. R&D grant receipt by Community development Foundation	
4	June.2005.	DISK Surface	CSM 04	Violet LD 405nm	Raster scan./work turn	1	Seagate Fremont CA.USA	Sales & Delivery
5	Aug.2005.	R&D Film for FPD	CSM 03	Red LD 655nm	Raster scan./work move	1	Fuji Firm-R&D Management Headquarters	Sales & Delivery
6	Sept.2005.	R&D DISK Surface	CSM 04	Violet LD 405nm	Raster scan./work turn	1	Optoelectronic Industry and Technology Development Assoc. R&D grant	
7	Mar.2006.	R&D FPD-DISK-Wafer	CSM X1	Red LD 655nm	Raster scan./work move	1	R&D grant receipt by Nagaoka-shi R&D grant	Demo-machine
8	Apli.2006.	Mask Cristal Surface	CSM 04	Violet LD 405nm	Raster scan./work turn	1	Sumitomo metal Fine Tech.-Osaka	Sales & Delivery
	Jun.2006.	**Patented "Shape measurement device" "CSM method" Patented No.3810749. 2.Jun.2006. 特許「形状測定装置」登録 平成18年6月2日**						**Patented**
9	Sept.2006.	DISK Surface	CSM 04	Violet LD 405nm	Raster scan./work turn	1	Peripheral Tech. Mil CA. USA	Sales & Delivery
10	Jan.2007.	R&D DISK Surface	CSM X2	Violet LD 405nm	Rotate scan /work turn	1	R&D machine in the company	R&D grant
11	Aug.2007.	Super conduction material	CSM 04	Violet LD 405nm	Raster scan./work turn	1	TANAKA KIKINZOKU KOGYO K.K.	Sales & Delivery
12	Nov.2008.	Si Wafer φ450mm	CSYS06-450	Violet LD 405nm	Raster scan./work turn	1	Kobelco Research Institute Inc.	Sales & Delivery
	Nov.2008.	**"Shape measuring equipment" wins invention commendation. Prize of Smaller Enterprise Agency's Director 中小企業庁長官賞受賞**						**Patent prize**
13	Dec.2008.	Si Wafer φ300mm	CSYS06-300	Violet LD 405nm	Raster scan./work turn	1	LAYTECHS Co, Ltd.	Sales Pending
14	Mar.2011.	Si Wafer φ200mm	CSYS10-200	Violet LD 405nm	Raster scan./work turn	1	Canon Inkjet Products Operations-Kawasaki	Sales & Delivery
15	Dec.2011.	Si Wafer φ200mm	CSYS10-200	Violet LD 405nm	Raster scan./work turn	1	Tohoku University MEMS Institute	R&D grant Pending
	July.2014.	**Patent Application "Shape measurement device" "CSYS-SF method" No.2014-140926. 特許出願**						**Patent Application**
16	Nov.2017.	Si Wafer φ150mm	CSM 10-150	Violet LD 405nm	Raster scan./work turn	1	NTT Device Technology Laboratories-Atsugi	Sales & Delivery
17-21	2018.-21.	DISK Surface	CSM 10-3.5	Red LD655nm W	Raster scan./work turn	5	Certain major DISK maker-oversea	Automatic Inspect.
22-24	2020.-24.	Si Wafer φ300mm	CSM 10-300	Violet LD 405nm	Raster scan./work turn	4	Certain major DISK maker-in Japan	Automatic Inspect.

Core System Corporate Profile

株式会社 コアシステム 会社概要

☆ Established：27, June 1997

設　　　立 ： 平成9年6月27日

☆ President & CEO : Masami ONODERA

代表取締役：小埜寺 正臣

☆ Head Office : 144, Nishimiyauchi 2-chome,
Nagaoka-shi, Niigata 940-1162
JAPAN

本社所在地： 〒940-1162 新潟県長岡市西宮内2丁目144番地

Tel : ＋81-258-31-6233　Fax :＋81-258-37-3744

e-mail : sales-1@csys-jp　URL : http://www.csys.jp

電 話：0258-31-6233　Ｆａｘ：0258-37-3744

☆ Capital : ￥54,000,000 Yen (present：June 2018)

資　本　金 ： ¥54,000,000円 （平成30年6月現在）