“KBTEM” JSC, Minsk, Belarus


Quality Management System Certificate ISO-9001 since 2001

SPIE Member since 2003

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Dr. S. Avakaw

SEMI Member since 2002
Agenda

1. Key points of KBTEM

2. Opto-mechanical equipment of KBTEM, based on laser technologies

3. Our new solutions
Belarus is located between Russia and Poland in the middle of the road from Munich to Moscow. The distance between Brest (Belarus) and Dresden (828 km) is approximately the same as the distance between Minsk, the capital of Belarus, and Moskow (700 km).

70% of Belarus's population of 9.49 million resides in urban areas.
1.2 KBTEM – the biggest part of Planar Holding

Planar Holding Include

- KBTEM JSC (570)*
- Planar-SO JSC (160)*
- Planar JSC (120)*
- Opto-Electronic Systems JSC (110)*
- Electronmash Factory JSC (50)*

*- number of employees

Mask production and wafer patterning equipment

Die Bonder, Wire Bonder

Wafer Probers, Dicing Tools

Atomic Force Microscops (AFM)

Medical Equipment (Heart Valves)
1.3 Head office of KBTEM is in Minsk, the capital of Belarus

570 Employees, 35 000 m² manufacturing and engineering areas, 1 500 m² cleanrooms
1.4 Key points of KBTEM

- KBTEM is 55 years in industry (was established in 1962)
- KBTEM have high level vertical integration in design and manufacturing
- KBTEM is a total solution provider for defect free mask manufacturing process
- KBTEM provides brand new tools only, no secondary or refurbished equipment:
  - proven tools for 0.8 µm, 0.6 µm, 0.35 µm, 0.18 µm, 0.13 µm and 90 nm technology nodes
  - Variety of wafer patterning and inspection tools
  - Maskless lithography tools
  - Unique solution for double-side lithography
1.5 Total 4516 Tools of Opto-mechanical Equipment are installed at more than 250 Customer sites (distribution according to types of equipment)
1.6 Our partners worldwide
1.7 Our partners in Russia and Belarus
2 KBTEM produce two groups of equipment based on laser technologies

2.1. Mask Production

2.1.1. Pattern generators

2.1.2. Automatic mask inspection tools

2.1.3. Mask defect repair tools

2.1.4. Special application pattern generators, photorepeaters

2.1.5. CD and Coordinates inspection tools

2.2. Wafer patterning

2.2.1. Contact printing and double-side lithography

2.2.2. Steppers

2.2.3. Direct Writer

2.2.4. Patterned and unpatterned wafer inspection

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2.1 Accordingly we can build Reticle Manufacturing Line

- **Reticle cleaning**
  - Technology Node 90 nm
- **Ion-plasma etching**
  - Technology Node 90 nm
- **Multichannel laser pattern generator**
  - Technology Node 90 nm
- **CD Measurement**
  - Technology Node 90 nm
- **Coordinates measurement and alignment ability control**
  - Technology Node 90 nm

**Development**
- Technology Node 90 nm

**Baking**
- Technology Node 90 nm

**BACK-END OF LINE**
- **Automatic pattern defect inspection**
  - Technology node 90nm
  - Pixel size 65 nm.
- **Defects repair**
  - Technology node 90nm
  - Min. element 200 nm.

**FRONT – END OF LINE**
- **Mask protection and packaging**
  - Technology node 90nm
2.1.1 EM-5189, EM-5289 multichannel laser pattern generators are based on raster scanning technique

**1. Competitors**
Applied Materials (USA) is manufacturing similar systems

**2. Competitive advantages (edges)**
1. Interferometer based measuring system has 0.6 nm step sensitivity and up to 15 nm alignment accuracy.
2. Certification system of 512 beams checks position and intensity and ensures 30 nm edge roughness with the throughput of 50 mil pixel/sec

**3. Marketing**
1. 2016-2017 - 3 Tools are installed
2. 2017-2018 - contracts with customers from Russia, China and Taiwan are on negotiation stages
2.1.1 Pattern Generators Specifications, patents which we have

**EM-5189-03**
- Proven UV laser system, 355 nm
- 350 nm design rule compatible
- Direct write on substrate (option)
- 16-beam architecture

**EM-5289B, EM-5589**
- DUV laser system, 257 nm
- 180 nm, 90 nm* design rule compatible
- PSM
- Direct write on substrate (option)
- 32-beam architecture

*under development

**Multibeam pattern generator Patent No15702**

**Multibeam pattern generator Patent No14775**

**Optical alignment unit for photolithography tool Patent No 17160**
2.1.2 EM-6329, EM-6729 Automatic Die-to-Database (D2DB) Mask Pattern Inspection Tools

1. Competitors
KLA-Tencor (USA) is the only competitor

2. Competitive advantages (edges)
1. Extremely high competitive throughput is ensured by the control system based on 18 Industrial computers, 8 specialized processors and 80-channel TDI CCD camera with the throughput of 400 megapixel/sec
2. Interferometer system with 0.6 nm sensitivity ensures more high reliability and repeatability of inspection than competitor’s tools

3. Marketing
1. 2016-2017 - 3 Tools are installed
2. B 2017-2018 contracts with customers from Russia, China and Taiwan are on negotiation stages
2.1.2 Mask Inspection Tools Specifications

**EM-6329R / EM-6329B**
- 180/130 nm design rule compatible
- LED i-line (365 nm) light source (EM-6329B)
- LED g-line (436 nm) light source (EM-6329R)
- Die-to-database inspection technique
- High throughput
- Small footprint

**EM-6729**
- 90 nm design rule compatible
- 266 nm laser source
- Die-to-database inspection
- Soft defects detection
- PSM phase contrast mode
- Very high throughput
2.1.3 Laser Mask Repair Tools EM-5131, 5201. 5141

4. Patents
1. Photoelectric rotational encoder Patent No 4468
2. Projection exposure system Patent No 12219

1. Competitors
Rave LLC (USA) is the only competitor

2. Competitive advantages (edges)
1. Laser pulse of 150 femtosec sublimes the 200 (150) nm mask area with no damage to the substrate
2. High NA optics provides defects repair of L/S structures with 200 (150) nm line
3. Deposition and evaporation repair methods are realized in one tool – this makes it different to the competitor system
4. Coordinates’ compatibility with the mask pattern inspection system for defect identification with high accuracy.
5. Copy repair and pellicle through repair functions

3. Marketing
1. 2016-2017 3 tools are installed
2. 2017-2018 contracts with customers from Russia, China, Taiwan and South Korea are negotiated
2.1.3 Mask repair tools specifications

**EM-5131**
- Femtosecond laser
- 0.2 µm feature size
- 7” x 7” mask (9”x9” option)
- Evaporation and Deposition Technologies

**EM-5201**
- Picosecond laser
- 0.5 µm feature size
- 810 x 610 mm mask
- Evaporation and Deposition Technologies

**EM-5141**
- Femtosecond laser
- 0.15 µm feature size
- 7” x 7” mask (9”x9” option)
- Evaporation and Deposition Technologies
2.1.4 Special application patterning tools

**EM-5109**
- 1 µm feature size
- Working field 300 x 300 mm
- Alignment accuracy 0.25 µm

**EM-5009M (emulsion)**
- 4 µm feature size
- Working field 153 x 153 mm

**EM-5062M, EM-5162**
Photorepeaters
2.1.5 CD and coordinates inspection tools

**EM-6239-01 Automated CD inspection tool**
- High definition optical system
- 0.5 μm feature inspection and 0.35 μm feature assessment in 365 nm (i-line)
- Visible light pattern viewing

**EM-6209 Mask pattern coordinates measurement system**
- glass metallized photomasks with low and ultra low thermal expansion coefficient
2.2 Wafer Patterning Tools

Image printing methods

Contact printing
- Illuminator
- Lens
- Photomask
- Resist
- Wafer

Proximity printing
- Illuminator
- Lens
- Photomask
- Resist
- Wafer

Projection printing
- Illuminator
- Condenser
- Projection lens
- Photomask
- Resist
- Wafer
2.2.1 Contact Printing Tools

**EM-5026AM Mask aligner**
- Ø100 mm (4 inch) wafer
- 0.5 ... 0.7 µm photolithography resolution
- ±0.1 µm alignment accuracy random component
- Automatic loading
- 225-260 нм; 280-335 нм; 350-450 нм
- DRKs 500 w (Ushio)
- 360-450 nm - LED

**EM-5096/EM-5026M1 Mask aligner**
- Ø76 mm (3 inch) wafer
- 0.4 ... 0.6 µm photolithography resolution
- ±0.1 µm alignment accuracy random component
- Manual loading
2.2.1 Contact Printing Tools

**EM-5026B**
Double-side mask aligner

- Ø100 mm (4 inch) wafer
- Alignment accuracy random component:
  - ±0.1 µm one side alignment
  - ±0.5 µm with reference to marks on the back side

**EM-5106 (5126) Mask aligner**

- Ø150 mm (6 inch) wafer
- 0.7 ... 1.0 µm photolithography resolution
- ±0.1 µm alignment accuracy random component
- Automatic loading

Double side alignment and exposure method Patent No 8442
2.2.2 Equipment for wafer projection imaging

**EM-5084B**
Automated stepper for 0.8 µm node

**Projection lens with 1/5x magnification**
Patent No 5713

**EM-5784**
Automated stepper for 0.35 µm node

**Projection lens with 1/5x magnification**
Patent No 5739
2.2.2 Large Area Steppers

**EM-5434M**
PCB stepper for high density PCB

Projection exposure system
Patent No 16195

Projection exposure system with 1:1 magnification
Patent No 5739

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**EM-5634**
CCD stepper for super large matrix and linear CCD photoreceivers

Projection exposure system
Patent No 12219

Projection exposure system with 1:1 magnification
Patent No 0586062

Method of exposure of wafer Patent No 1326012
2.2 Lithography tool EM-5186 makes the reference mark on the back side of wafer for back side alignment

EM-5186
Double side alignment mark placement system
- Ø150, 200 mm (6, 8 inch) wafer
- 0.3 µm random component of marks alignment accuracy on both sides of the substrate
2.2.4 Tools for unpatterned wafer inspection

**EM-6479**
Automated unpatterned wafer defects inspection
- Ø200 mm (8 inch) max wafer diameter
- 150 nm min detected defect size

**EM-6319T/EM-6419**
Wafer flatness inspection
Ø150/Ø200 mm (6/8 inch) wafer

Unit for noncontact measurement of thickness of wafer Patent No 3298
2.2.4 Tools for patterned wafer inspection

**EM-6429/EM-6429B**
Automated patterned wafer microdefects inspection
- Ø150-Ø300 mm (6-8 inch) wafer
- 0.25/0.09 μm detected defect size

**EM-6529**
Automated patterned wafer macrodefects inspection system
- Ø200 mm wafer  20-50 μm detected defect size

**EM-6239**
Automated CD inspection system
- Ø200 mm (8 inch) max. wafer size
- CD inspection λ=365 nm
- Pattern observation in visible light
3 Main trends in the future of lithography

- **E-Beam technologies**, including mapper
  - 248 (257) nm LASER PG
  - 32-64 beams, including immersion
  - 193 nm STEP & SCAN, including immersion
  - EXTREME UV 13,5 (11,4) nm projection lithography tools

- **Immersion lens**
  - Very complicated Infrastructure and cost of development and manufacturing
  - No Yield

- **Step 1**
  - 90 nm
  - 65 nm

- **Step 2**
  - 45-32 nm
  - 22 nm
  - 10 nm
Currently we have three R&D projects for new generation of Laser Tools for 65 nm technology

EM-5141 Mask Repair tool with
min. defect size 150 nm

EM-5589 Multichannel Laser Pattern Generator with
min. feature size 250 nm

EM-6929 Automatic Die to Database Inspection system
with min. defect size 65 nm
3 We hope that in the near future we will see following new Laser Based Technology pattern generator systems.

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<th>Technology Node, nm</th>
<th>Scanning System Type</th>
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Thank you