The Mycronic path back to Semiconductors and into Deep Learning

Thomas Kurian, Feb 25th 2020
Mycronic enabling manufacturing of products for every day life

By producing equipment for advanced manufacturing of electrical products

Business area PG
Mask writers & metrology

Business area AS
Assembly equipment
Mycronic in short

40 years of experience in innovation

1300 employees in ten countries

50 Mycronic is represented in more than 50 countries

500 patents proves the power of innovation.

3,000 customers use production equipment from Mycronic

98% of consolidated net sales are exports
Display production using photomasks

Lithography a capital intensive process but highly cost effective

- Mask writer – writes the photomask
  - 24-48 hours writing time
  - ~25 Terabyte data
  - Transfer rate ~1.2-2.5 Gbit/s

- Aligner – copies the photomask
  - ~20 seconds to copy the photomask
  - ~25 Terabyte data
  - Transfer rate ~10 Tbit/s

Lithography using photomasks is the only technology used today in mass production to create high end electronics and high end display TFT back planes
Mycronic has a unique position as the sole supplier of mask writers to the display industry.

Can handle photomasks up to 1.8 x 2.0 m

“The mura (斑) challenge”
- Japanese word meaning irregularity

....So literally you could say that all mass produced high end displays in the world has a connection to Mycronic...
Mycronic mask writers

Offering nanometer precision

Mycronic’s Prexision-800 delivers nanometer precision
Display trends in favor for the photomask industry

Transition from LCD to AMOLED

- Drives mask complexity

Higher and higher resolution

- ~60 PPI
- ~160 PPI
- ~400 PPI

- Drives mask complexity

Larger and larger displays

- Drives mask size

Displays in new applications

- Drives additional demand & new requirements
The new SLX Series
The laser mask writer for tomorrow’s semiconductor market
The electronification of everything

More devices will need processing power to keep up with the pace of change
Laser writer demand on the rise

Additional demand driven by both market trends and technology trends

Sources: Mask maker survey 2018 and 2019 (https://www.ebeam.org), Renew, Retire, Replace by Franklin Kalk, Toppan, Photomasks (https://www.ebeam.org), Myronic estimates
Laser writer demand on the rise

Additional demand driven by both market trends and technology trends

- Around 600,000 photomasks enable the semicon industry today
- 70-75% of these masks are written by laser

Sources: Mask maker survey 2018 (https://www.ebeam.org), Mycronic estimates
In excellent position to capture the opportunity
Leveraging existing display technology and customer relationships

Despite competition in segment our ambition is to capture a majority of the upcoming opportunity with the SLX-series and over time establish a strong presence in the mature semicon segment
The SLX value proposition

Born to run
(first shipment expected year end 2020/21)
The new SLX Series

The laser mask writer for tomorrow’s semiconductor market

- Available in different configurations
- Writing times from 20 minutes
- Meets requirements down to 90 nm node
Applying Deep Learning Methodologies to Improve Mask Shop Operation
Logging of Writer Servo Data
Writer Servo Log Visualization

Looking for mura in the data
Writer Servo Log Statistical Analysis

FFT of Strip Data

XsDev: XsOut: XiPos-XsPos HP:
YsDev: YsOut: YiDev:
ZsPos HP:
FsDev: FsOut:
FlowA:
RefA:
DoeDev: DoeOut:
Deep Learning
CDLe & Deep Learning Competence

- Long Term Assignee
- Short Term Assignee
- Not Yet Assigned

Long term Assignee
Romain Roux
Anomaly Detection Using Autoencoders

Capturing Normal Behavior

Are these similar?
Anomaly Detection Using Autoencoders
Capturing Abnormal Behavior

Encoder
Coded Input
Decoder

Same = Normal
Anomaly Detection Using Autoencoders
Capturing Abnormal Behavior

Encoder \quad \text{Coded Input} \quad \text{Decoder}

Not Same = Abnormal
Anomaly Detection Using Autoencoders
Capturing Abnormal Behavior
Using the Available Data Efficiently

Deep Learning opens up new possibilities

Step 1: Collect data
- Mask writer log data
- Potentially also mask quality data

Step 2: Analyze data
- Statistical methods
- Deep Learning

Step 3: Turn data into valuable insights

- Preventive & Predictive maintenance
- Improved Quality control
- Generate ideas for improvements
Thank You!