DaLI Direct Laser Lithography

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Lithography

• transfer of a pattern to a photosensitive material
• process used in microfabrication to pattern parts of films different thickness

• Types of photoresists:
  ❖ Positive PR - Exposed regions dissolve
  ❖ Negative PR - Unexposed regions dissolve
  ❖ Image reversal PR
There are different types of UV lithography.

Lithography with mask
• Simple and fast exposure for larger wafers
• Same patterns for mass production
• Mask is expensive and it can’t be changed

Direct laser lithography
• No need for masks
• Rapid prototyping system
• For research and development process
DaLI - An overview

• Table top device
• Thermalization ensures ultimate precision
• Operated entirely through software
• User friendly
• In-house prototyping

• Substrate size up to 100x100 mm
• Laser wavelength 375 nm
• Laser spot size (TEM00) 1 \( \mu \)m and/or 3 \( \mu \)m (software selectable)
• Laser spot positioning resolution <1nm
• Writing speed up to 100,000 spots per second
• Structure size down to 1\( \mu \)m
• Data input formats DXF, BMP
• Devicedimensions 650 ×522 ×626 mm, 80 kg
• Integrated microscope for sample alignment and inspection
DaLI through the eyes of a user

Design a microstructure → Prepare sample → Perform exposure
An intuitive way of designing a microstructure using CAD

- many drawing tools available: line, polyline, circle, rectangle, array, ...
- import filters: dxf, bmp
- modify imported structure: move, scale, rotate, mirror, ...
- Five (5) standalone versions of DaLI software available: design your structure on a dislocated PC
The sample is easily prepared for illumination

- sample mounted in customizable holder and slid into device
- sample levelling enables exposing surfaces of irregular shapes
And pre-existing structures can be used for anchoring

- Sample anchoring enables:
  - positioning, scaling, rotating of the new structure relatively to the existing structures
  - marking small target surfaces
Working parameters control the process quality

- Assign working parameters
  - Fine (1 μm) or coarse (3 μm) laser beam
  - Spot spacing
  - Exposure dose [mJ/cm²]

Small spot spacing results in high details and crisp, sharp edges. Large spot space provide fast exposure of larger areas.
AZ 1505

- Positive photoresist
- Thickness up to 700nm
- Resolution down to 1µm
- Application in manufacture of microelectrodes, electrical circuits, transistor chips, manufacture of masks on Chromium

Width at the bottom: 195nm
Lines are 1µm
Gap between lines is app. 2 µm
SU-8 2050

- Negative photoresist
- High aspect ratio imaging with near vertical walls
- Thickness up to 200 µm
- Application in microfluidics, manufacture of channels, filters, particle traps, manufacturing of micromolds.
Ma-P 1275

- Positive resist
- Thickness up to 60 µm
- Applications in microfluidics, binary lithography, for etching, metal deposition, lift off process

Each step is app. 700nm
LOR 3A and S1805

- Combination of 2 photoresist for undercut profile
- Applications in electronical circuits, transistor chips
Last thoughts...

- DaLI system is constantly evolving to have higher resolution
- System is perfect for research institute as we use it for different applications
- System is thermally independently thermalized so it doesn’t need special environment
- In lithography is also very important how do you prepare sample, as it effects on exposure

Thank you for your attention!