MicroPG 101 Pattern Generator Standard Operating Procedure
Draft v.0.2

QUICK GUIDE

PROCEDURE OVERVIEW

1. Log in on Mendix
2. Transfer your file into designs folder
3. Place your sample onto chuck, and turn on properly distributed vacuum
4. Load your design into microPG exposure wizard and verify the layout
5. Set up an exposure job and expose pattern
6. When exposure is complete, unload your sample
7. Do not close software
8. Prepare and expose another sample OR log out on Mendix

CRITICAL PRECAUTIONS AND COMMON MISTAKES

- Make sure Advanced Wizard is checked
- Never open coverlid when an exposure job is running (you cannot resume it)
- For SU8 thicker than 100 microns, contact staff before processing
- Remove edge bead before loading sample into machine
- Center your substrate on the chuck
- No alignment pins can remain on the chuck during exposure

Before you start

- LOG IN online @ https://mendix.princeton.edu/
- Pattern Files: GDSII, CIF, DXF, GERBER
- Samples: Fresh photomasks (MNFL supplies standard Cr masks with soda lime glass plates, both 4 inch and 5 inch in size, manufactured by Nanofilm) or substrate coated with photoresists (substrate OD must be ≥ 10 mm).
- For wafers, clean backside before placing onto chuck

Tool condition for the next user

- Stage free of sample.
- Do not close software
MATERIALS RESTRICTIONS

- No edge bead on samples
- No resist on back-side
- For exposures of SU8 thicker than 100 microns contact staff

SUSPENDABLE OFFENSES

- Placing dirty samples and contaminating the chuck
- Not properly removing edge-bead

HANDLING REMINDERS
TOOL OVERVIEW

The Heidelberg microPG is a medium resolution pattern generator optimized for direct writing SU-8 negative tone photoresist, although it can expose regular positive tone resist and masks as well. Its capabilities and flexibility make it an ideal lithographic tool for research. It uses acousto-optic modulators to adjust the laser intensity, and acousto-optic deflectors to scan the beam. During an exposure, only the stage moves. The substrate is held down on the stage by vacuum and moves in the x-y plane.

The optical setup utilizes a single-mode diode laser ($\lambda = 375$ nm) as its light source. The 10 mm head acts as a focusing objective with resolution of 2.5 microns. Smaller line width is possible with careful tailoring of the exposure conditions. The head is equipped with both pneumatic sensor and optical sensors for auto focus. Using optical sensor, it is possible to write very close to the sample edge and to expose over large topography. For additional flexibility of exposure energy, there is a single 30% filter that can be engaged with a turn of a knob.

Advanced options include automatic and manual centering for both rectangular and circular samples, alignment for multi-layer processing, and setting up bath exposures for dose test. Separate training is required to use manual alignment with marks on substrate.
FULL PROCEDURE

1. Prepare your substrate
   a) Remove edge bead either with swab soaked in solvent or with razor blade before soft-bake. Failure to clean edge bead can result in serious damage to the write head.
   b) Clean back-side of the substrate with swab. Any residue on the back-side will damage the vacuum chuck of the tool.

2. Transfer your data into the tool
   a) Make a folder for yourself inside the “Designs” folder. Use your username as the name.
   b) Use USB memory stick to transfer layout files. Plug the stick into the left side of the monitor (or in the back of the computer). Copy your design file (gdsii, cif, dxf or gerber) into your folder.

3. Load your substrate
   a) Open the cover lid.
   b) Place your substrate on the vacuum chuck, centering it by eye and paying attention to the tool's coordinate system (positive Y to the left, positive X towards the back).
   c) Adjust vacuum field selection screws (white screws on the front) to distribute vacuum over the back-side of your sample.
      Note: for 4” wafer all small holes must be covered.
**4. Set up your exposure**

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<th>a)</th>
<th>If the software is closed, open it by going to Himt-Shortcut → uPG101 Exposure wizard. Under Tools, make sure there is check mark next to Advanced Wizard.</th>
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<td>b)</td>
<td>In the exposure wizard, click “Expose New Design” or “Select New Design”</td>
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- d) Turn on vacuum by flipping the switch on the left

- e) Close cover lid
c) Navigate to your folder and double click your file. Wait for it to be loaded and for options menu to open

1. If GDS file type was selected, choose correct GDSII structure (cell) and check or uncheck which layers are to be exposed. Note: the selected layers will merge together into one exposure. Click “Create”
2. If DXF file type was selected, enter conversion of dxf units to nanometers and click “OK”

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d) Verify the Size X/Y of your exposure. Make sure the exposure does not extend beyond your sample where not necessary

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e) Click “NEXT >”

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f) Click “Show Control Panel” if it is not open.
g) Select correct Exposure options
   1. Select exposure energy in mW and % filter.
   2. Change energy mode (speed) if necessary:
      (number of passes) x (speed reduction factor)
   3. Turn on “Automatic Centering” to center your job on the sample

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<td>![Expose Options Image]</td>
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<table>
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<td>![Design Options Image]</td>
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h) Flip 30% filter switch on the side of the tool into correct position (on or off)

i) Click “Next >”

j) Under Controls, click “To Center” to move the sample under the lens. Make sure the lens is over the sample and not over uncovered part of the stage. Serious damage can occur during focusing if the lens is not directly above the center if your sample.

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<td>![Stage Control Panel Image]</td>
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### k) Select correct focus mode and click “Focus”. For large substrates and masks use pneumatic. For pieces smaller than 2x2 cm use fast optical. If not sure, contact staff.

![Focus mode selection](image)

### l) Perform centering if required. For most application, plate center is acceptable. Click “Find Plate Center”, then “Start”. Once the centering is done, click “Accept”.

![Centering options](image)

### m) Click “Next >”

![Next button](image)

### n) Make sure “Auto Unload after Exposure” is checked on, and click “Expose”

*Optional: if you experience stitching errors, you can enable “Uni-Directional mode”. This will double your exposure time, but may help stabilize the laser position.*

![Expose options](image)

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### 5. Unload your substrate

- a) When exposure is complete, click “Ok” in pop-up window
- b) Open the cover lid
- c) Turn off vacuum switches
- d) Remove your substrate from the tool and close the cover lid
- e) To run another sample, click “Expose same Design” or “Expose new Design”
- f) Else, if done, do **not shut off software**
APPENDIX A: LIST OF ADVANCED FEATURES

Only approved users are allowed to perform these features.

- Advanced alignment to previous layer for multi-layer processing
- Manual CAD offset relative to either sample center or stage center
- Set up of batch for dose/focus arrays: useful for characterizing new resists and resist thicknesses, dose tests
- Enabling of pure OAf
- Focus offset and manual focusing
- Fixed focus option (instead of dynamic focus that is default)

Please contact Staff regarding these features.

APPENDIX B: SYSTEM STARTUP

APPENDIX C: SYSTEM SHUTDOWN

TROUBLESHOOTING