Mask Making at the NanoLab

(Optical Pattern Generator)

Getting Started

Review Nanolab Chapter 3.1 to get important design rules and templates for the exposure system being used: https://nanolab.berkeley.edu/labmanual/chap3/3.01maskmaking.pdf

Layout – what formats are used?

To submit a design, use any CAD software which generates a GDS, TDB, DXF, or CIF file. All file formats need to be converted to a TAP and TIX file specific to the pattern generator. Using the GDS format is recommended. Formats are converted in the following manner:

TDB → GDS → TAP/TIX
DXF → GDS → TAP/TIX
CIF → TAP/TIX

How do I Convert these file types?

External (Non-member)

Non-member mask requests are welcome. If unable to submit CIF or TAP/TIX file formats, NanoLab Staff can assist with the conversion for a flat rate of $150 per layer. E.g. a three layer mask set will cost $450 for the file conversion.

Internal (Nanolab Members)

TDB to GDS and DXF to GDS Conversions: Current NanoLab Members can perform these conversions with Tanner L-Edit. The software is available on computers in the gowning area and also remotely. For more details on remote license setup see:

https://nanolab.berkeley.edu/member/computers/computeruse/apphelp/tanner.shtml

GDS to TAP/TIX Conversions: Current NanoLab Members can use Artwork Conversion Software (http://www.artwork.com) available on the mercury4 server. Follow directions in Appendix G of NanoLab manual 3.1:

(https://nanolab.berkeley.edu/labmanual/chap3/3.01maskmaking.pdf)

CIF to TAP/TIX Conversions:

Email CIF files to Marilyn Kushner (marilyn (aat t) eecs.berkeley.edu).

Are there any other important considerations?

- Made sure your design agrees with all design rules from Nanolab Manual Chapter 3.1.
- If you cannot provide TAP and TIX, or CIF files, we will make the best effort to convert your GDS, TDB, or DXF files. In this case, submit also the name and number of design layers to process, the name of the topmost cell, the required magnification to be made on the design and the plate parameters. Conversion is charged for a flat rate of $150 per layer. E.g. a three layer mask set will cost $450 for the file conversion.
- During conversion each layer is centered according to their maximum height and width. If there are multiple layers that need to get aligned to each other, the placement of a common frame around the design is suggested to avoid misalignment.

Jeff Clarkson
March2015

- The pattern generator creates the mask by flashing various size rectangles. The minimum single flash and maximum single flash size is 2 um x 2 um and 900 µm x 900 um, respectively. Objects larger than 900 um in one dimension must be > 5 µm in all dimensions. Lines longer than 900 um can be broken or misaligned at the meeting point of the flashes if < 5 um wide.
- A mask is created by single flashes of the pattern generator. We do not make masks larger than 150,000 flashes.
- If the layout does not convert at the first attempt, the file will be returned to the sender for modifications. If conversion fails after multiple tries, mask request might be denied. If the file conversion is finished and you elect not to have your masks made in the NanoLab, you will still be billed for the conversion.

Note: For conversion details, available utilities, and suggestions please see the online lab manual Chapter 3.1. For GDS to TAP and TIX conversion, the script called 'gds2tap' is suggested for use.

How do I submit my mask request?

External (Non-member)

External, non-member requests can be made by e-mailing TAP and TIX, or CIF files to Marilyn Kushner (Marilyn (aatt) eecs.berkeley.edu).

Internal (Nanolab Members)

Current NanoLab members can request masks online in Mercury Web by selecting Member, Process, and then Mask Request. When requesting masks in Mercury, please provide a clear file path for the location of your TAP and TIX files.

Mask Making

The total mask cost comprises of the following:

- **Machine Time:** Determined by the size of the layout. This value is shown as flash count after conversion has finished. The pattern generator makes approximately 6,000 flashes per hour. The number of boxes in the converted file determines the number of flashes the pattern generator will process to make the mask pattern. For instance, if a file has 12,000 flashes, it will take about two hours to complete the job. Time can increase with the presence of complex design, e.g. angled design or arcs. Pattern Generator charge: $42.00/hour.
- There is a minimum 30 minute pattern generator machine time charge for every mask made.
- **Staff Time:** Consists of conversion (if applicable) and processing time.
  Process staff service: $78.60 per hour and per mask plate (as of Feb. 2015, subject to change).
  Conversion fee: $150 per mask
- **Materials:** Cost of photomask plate and mask package
- **Shipping:** For external mask requests; shipping with FedEx has a flat rate of $20 for overnight/next day delivery.
- Non-UC Universities are charged an additional 8% for campus administrative fees; the NanoLab is charged an 8% fee by campus for all services we provide for non-UC universities.

Jeff Clarkson
March2015

2.5” chrome plate	$14.00 each
2.5" emulsion plate	$17.00 each
4” chrome plate	$17.00 each
5" chrome plate	$24.00 each
5" iron oxide plate	$33.00 each
5" emulsion plate	$37.00 each
7” chrome plate	$86.00 each
6” quartz plate (ASML masks)	$172.00 each

NOTE: Mask prices have been rounded up to the nearest dollar. Exact cost of each mask plate can be found on the Mercury Web. Prices listed here are from February 2015 and are subject to change.

Price Quotation

- Price quotation cannot be given until the layout size and flash count is known. The file has to go through conversion to get exact values.
- After conversion, you will receive an estimate of total costs only if requested.

Purchase Order for External Universities

After you have a cost estimate, establish a Purchase Order.

To establish a mask-making account at the NanoLab, please email Neal Melton (nmelton (att) eecs.berkeley.edu) to start the required paperwork. Include the following information:

- Full name, address, telephone, and fax number of requester.
- Full name, telephone number and e-mail address of administrative contact.
- For non-UC system orders, Purchase Order must include:

1. Purchase Order Number
2. Billing and Federal Express Shipping Address
3. Approved Dollar Amount (“Not to Exceed” amount okay)
4. Period of time PO is valid
5. Federal Tax ID Number

For UC system requests a full account/fund or chart string number must be included. (Please note that a 4-digit recharge ID number alone is not acceptable.)

Note: When Neal Melton is on vacation, e-mail Susan Kellogg-Smith, (kellogg (att) eecs.berkeley.edu).

Service

The UC Berkeley NanoLab provides mask making services only to university-affiliated clients.

Jeff Clarkson
March2015