Preparation of Chrome Masks from Emulsion Transparencies

STANDARD OPERATING PROCEDURE

CORAL
Name: --

Model
Number: --

Location: TRL

What it
does: This is a fabrication procedure

Introduction: This procedure describes a method for preparing emulsion-based transparencies from standard PC-based CAD/graphics application and the transfer of features on these transparencies to chrome masks for subsequent use in MTL for either Au or non gold-contaminated processing. This method can be used to produce masks with feature sizes greater than or equal to ~25 microns. Transfer to Chrome plates allows a reduction in contamination from the transparency, which essentially can not be made clean enough for CMOS processing, and has the advantage of allowing second level alignment which can not be done with a flimsy transparency.

Safety: Get training on and follow the standard safety procedures associated with the use of mask aligners ksaligner2 or EV1, photo-wet, and acid-hood or acidhood2.

Procedure: Design and Output of Emulsion Transparencies: The vendor who we have typically used for outputting electronic files to emulsion transparencies (via. a laser-assisted imagesetter) is:

Pageworks 501 Cambridge Street Cambridge, MA 02141
Phone: (617) 374-6000 Fax: (617) 374-6020
http://www.pageworks.com

An alternate vendor is http://www.photoplotstore.com/pages/prices.html .

You will need to set up an account with Pageworks (you can download the form on the web) -- multiple people can be authorized on an account, so one per research group will suffice. It is easiest to set up a blanket purchase order (which you can do through the Procurement Office at MIT; details are on their webpage: web.mit.edu/sapweb) -- this avoids having to deal with getting a new P.O. each time you need a transparency.

Pageworks can work with many types of files (check their webpage or call for details), however, we have had most success with Using the graphics application, Macromedia Freehand MX 2004(~$90, academic version, available from GovConnection via SAPweb). Please note that this is not a technical drawing program but it can be used successfully with larger geometries. You need only save your file as a standard Freehand file (*.fh11).

If you typically work in AutoCad, then follow the procedure outlined below:

? Save your file as a .dxf file. Freehand MX is compatible with AutoCAD dxf up to version 12 (Windows). If you have version 12 (or can save as version 12 from AutoCAD 14), then you will still be able to use this procedure. DXF 12 imports into Freehand with a scaling error. All your geometries will be scaled 100-1000x larger than you drew them in AutoCAD and would cause an error if imported into Freehand (your file would be larger than the pasteboard). So, step 1 is to scale your objects in AutoCAD down by a factor of 100. Then save as DXF12.

For further reading:
http://www.macromedia.com/support/freehand/ts/documents/no_dxf_export.htm
http://www.macromedia.com/support/freehand/ts/documents/presalesfaq.htm

? Import the *.dxf file into Freehand. Your file will look like a mess of black because the linewidths are importing with a finite thickness. Select the entire window of objects, and set the linewidths all to 0.00.

? Scale your objects to the correct size. You will need to use the scale command to generate the proper size for your objects. First change the default units in Freehand to millimeters. Then measure the length of an object of which you know the true dimensions, and use the scale command to bring the entire drawing to the appropriate size. You should be able to hit all your dimensions to within 50 nanometers or less Using this method.

? Fill in the device fields. Each closed polyline from AutoCAD must be filled in for printing, i.e. the file needs to appear in Freehand exactly as you want it to appear on the transparency or the exact opposite (because you can print the file either as a positive or negative image). Fill in your objects by selecting the closed features with your mouse and then choosing black from the fill menu.

? Draw mask box and center your design. Select all the objects on your mask and group them together. Draw a 5î x 5î (127 x 127 mm) box with a linewidth of 0.5 mm (500 microns). Center your mask design in this box. This step is not critical, but will make centering your mask on the chrome plate easier.

? Save file. Print your file on a laser printer and examine for nominal adherence to your expectations. Save the file as *.FH8 and follow the directions below.

Once you've prepared your file, you're ready to send it out to be printed
(most of these details are available on the Pageworks webpage).

1. Make sure your file is in a format that is suitable for Pageworks. It's often helpful to put a 5" x 5" box centered around your features to make alignment on the chrome plate easier.

2. Submit your file to Pageworks. Log onto their anonymous ftp website at ftp://ftp.pageworks.com /ftp.pageworks.com Login as anonymous and use your email address for the password. Drop your file off in the incoming folder.

3. Then, either download the Prepress Order Form from their website, complete it and fax it back to them, or fill out their online Prepress Order Form. Each page is $19.95 + $6.10 (if you have delivered by the Pageworks Courier). Most of the order form is self-explanatory, the only questions that may arise are around the section, Output Type, and the options are:

Media : RC Paper/film pos/film neg
Choose film pos or film neg depending if you want a clear field or dark field mask.
Emulsion : down/up This tells them whether you want the emulsion on the front or backside of the transparency -- you will bring the emulsion side into contact with the resist-coated plate (to ensure good pattern transfer) so when you then bring the chrome into contact with your wafer, the pattern will be flipped. So think now about which orientation you need .
Resolution : 1270/2540/3386, 3386 is what you want -- highest resolution.
Leave the rest of the boxes blank : they deal with color images. If you have questions, talk with the Pageworks folks.

4. If you submit your job by 6 p.m. (weekdays), the job will be ready and delivered to your door (if you requested that) by 9 - 10 a.m. the following morning. You're now ready to transfer your transparency to chrome, provided that you remembered to order chrome plates.

Procuring Chrome Plates and Developer

You can purchase pre-coated, blank chrome plates from Telic Company (see details below). Other vendors exist, but we have no experience with them. The lead time is 2-3 weeks, so plan ahead.

Telic Company (Contact: Bob Parille, East Coast Branch)
4165 Magnolia Street, Palm Beach Gardens, FL 33418
(561) 775-9254 (561) 627-0254 (fax)
http://www.telic2000.com - www.telic2000.com

Standard Specifications :
(minimum order: 20 plates)
substrate : soda lime
dimensions : 5" X 5" X 0.09" for 4" wafers, 7 X 7, 0.12" for 6" wafers
flatness : master grade (< 5 microns), $25/60
print grade (~10 microns), $17/50plate
resist : AZ 1500 Series Resist (typically 5300 angstroms), standard

Now that you have your transparency and pre-coated chrome plates:

1. As you enter TRL, Using a clean vinyl glove, remove your transparency from the plastic bag it arrived in for entry into the lab, or wipe down the plastic bag with IPA.

2. Check equipment reservations in CORAL to ensure that you reserved the correct machines, and engage and disengage them, as appropriate.   The first tool you will use will be an aligner; usually EV1 but you can use ksaligner2 if your masks are no bigger than 5".

3. Take your transparency and carefully cut it out of the 8.5" x 11" page with either scissors or a razor blade - it is easier if your transparency is the same size as your chrome plate.

4. Set up the aligner as you would for processing a standard silicon wafer. Place one of the resist-coated chrome plates on the chuck where you would usually place the wafer, Cr/resist side up, and centered as well as possible. Choose "soft contact" if Using ksaligner2, set at about 30 sec to a minute, or "flood" exposure with EV1, at about 5 sec.   In either case, do not insert a maskholder, but instead place the transparency, emulsion side down, on the chrome plate, and place a blank mask on top of the transparency, to hold it flat in contact with the chrome plate, again without Using a maskholder, then expose. *** This is not an SOP for either mask aligner! ***

5. Develop the resist in AZ 915 Using the dedicated blue-dot (Cr is a metal, so don't use green-dot!) or red-dot glassware and mask holders, as appropriate. It should develop in about 60 s. As with the other resists, rinse the plate thoroughly with DI after developing.

6. Once all your masks have been developed, you're ready to etch the chrome in acid-hood or acidhood2, if it isn't Au.   *** This is not an SOP for either acidhood! *** Again use the correct dedicated glassware and mask holder. The chromium etchant, CR-7, is easily identified because it's a bright orange color. Pour the etchant into the dedicated glassware. Place the chrome plates into the etchant, Using a 5" mask holder on end or a specially built 7" maskholder, one at a time: they will etch at about 1400A/min (depending on the exposed area and the number of plates that have

been etched in the same bath). If your chrome blanks have about 1000A of Cr, you would likely etch for almost a minute, making sure to overetch about 20% longer by time beyond what appears to be needed, judged by the unaided eye. Be careful, traces of thin Cr are not obviously visible to the bare eye and u-scope inspection is critical.   An advantage of over-developing and over-etching when Using transparencies is doing so will wash out small point defects which can be associated with transparencies.   Rinse well with DI and blow dry so you can u-scope inspect.

7. Once the Cr has been fully etched, strip the photoresist by doing Nanostrip acid clean, after confirming the Cr etch, in the same glass labware after aspirating/rinsing the CR-7.   Rinse and dry; your chrome plates are complete.

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