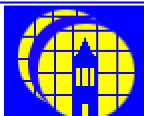
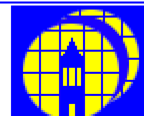


# Nanolab Process Manual



Process 1.3

## *Blue & Gold Show Wafers*

### *1.0 Process Summary*

**1.1** This process details a method for creating a decorative wafer pattern used for Nanolab awards.

### *2.0 Material Controls & Compatibility*

**2.1** Substrate

**2.1.1** Any clean, bare silicon wafer substrate of at least test-grade quality is acceptable. Always use new wafers to begin this flow.

**2.2** Storage

**2.2.1** It is recommended that furnace runs load as many wafers as possible at a time for these processes. Oxide/Si3N4 stacks can be stored indefinitely prior to the lithography step. (Practical storage time is limited by rate of particulate contamination in box)

### *3.0 Applicable Documents*

**3.1** Nanolab Manuals

**3.1.1** Chemical hygiene plan

**3.1.2** msink6/8

**3.1.3** tystar1, tystar2, or tystar3

**3.1.4** tystar9 or tystar17

**3.1.5** svgcoat1

**3.1.6** svgdev1

**3.1.7** quintel or ksaligner

**3.1.8** UVBake or Axcelis

### *4.0 Definitions & Process Terminology*

**4.1** Oxide: Silicon Dioxide

**4.2** Nitride: For the purposes of this process manual all nitrides are intended to be stoichiometric nitride (Si3N4)

### *5.0 Safety*

**5.1** Processing

**5.1.1** Furnace processing involves severe burn hazards.

**5.1.2** Several chemistries in this process can poison or harm operators. Always strictly follow equipment safety standards and CHP guidelines for wet chemistry operation.

### *6.0 Process Data*

**6.1** N/A

## *7.0 Process Explanation*

**7.1** Material Stack

**7.1.1** The depositions on the substrate are a two layer stack of 1000 A oxide and 2000 A standard nitride. These give a distinct blue and gold coloration to the respective layers.

**7.1.2** The mask is an inverted tone mask which protects the bright spots with photoresist and exposes the areas where darker tones are desired.

**7.1.3** The halftone screen converts shading to a pixelated mesh of 100% white and black spots. This allows us to use simple photolithography processes to define our image.

## *8.0 Process Procedure*

**8.1** Image Preparation

**8.1.1** Obtain image file for show wafer

**8.1.2** Load in Photoshop

**8.1.3** Click Image -> Canvas Size

**8.1.3.1** Select 6 inches for height and width

**8.1.4** Under “add an adjustment” click “Invert” (Figure 1)

**8.1.5** Click Image -> Mode -> Greyscale (Figure 2)

**8.1.5.1** When prompted to discard color information, click “Discard”

**8.1.6** Click Image -> Mode -> Bitmap (Figure 3)

**8.1.6.1** When prompted to flatten layers, click “ok”

**8.1.6.2** Choose resolution output of 450 pixels/inch (Depending on image)

**8.1.6.3** Choose method - > “halftone screen”

**8.1.6.4** Click OK

**8.1.6.5** Choose 450 lines/inch

**8.1.6.6** Choose angle of 45 degrees

**8.1.6.7** Choose shape of Round

**8.1.7** Note inverted mask should look like photonegative of picture – this is intentional.

**8.1.8** Save file as .BMP

**8.1.9** Print on inkjet printer and **use inkjet transparency, rough side facing the ink. Do not use laser printer transparencies.**

**8.1.9.1** Note: check printer with normal paper first.

**8.1.10** Attach mask to blank glass mask plate with tape.

**8.2** Fabricate Show Wafer Blanks

**8.2.1** Check for stored Blue & Gold Blanks – if less than 10, complete this section, otherwise move on to image patterning.

**8.2.2** Clean wafers in msink8 and then msink6 with full piranha/HF treatment.

**8.2.3** Load wafers into tystar2

**8.2.4** Using tystar2, run 2WETOXA with the following parameters:

**8.2.4.1** Temp: 1000 C

**8.2.4.2** Time: 9 minutes 52 seconds

**8.2.4.3** This generates a 1000Å thermal oxide (blue)

**8.2.5** Check the tystar9 monitor deposition rate and calculate required time to generate a 2000Å stoichiometric nitride film. (Roughly 60 minutes +/- 10 minutes)

**8.2.6** Using tystar9, run 9SNITA.

**8.2.6.1** Input your run time from the above calculation

**8.2.6.2** This generates a 2000Å stoichiometric nitride film (gold)

**8.2.7** You may store several "Blue & Gold Blank" wafers at this point – it is recommended to always have 10 backups in case patterning and etch encounters processing issues.

**8.3** Spin Coating

**8.3.1.1** Transfer 5 wafers from your Blue & Gold blanks storage to a new cassette labeled Show Wafer Blanks

**8.3.1.2** Spin coat i-line resist onto your wafer blanks using svgcoat 1

**8.3.1.2.1** Use process program 1 and bake program 1

**8.4** Exposure and Development

**8.4.1** Expose a wafer using ksaligner/quintel using monitor exposure values and inkjet mask prepared above

**8.4.2** Develop the wafer with svgdev1

**8.4.2.1** Use bake program 1

**8.4.2.2** Use develop program 1

**8.4.3** Check quality of developed pattern – Repeat above steps as necessary until developed pattern is acceptable

**8.4.4** Repeat Spin Coating and Exposure and Development steps to create 5 high quality patterned wafers ready for etch.

**8.5** Hard Bake

**8.5.1** UV bake wafers with program A on axcelis or uvbake

**8.6** Etch

**8.6.1** Obtain one dummy p-type test wafer

**8.6.2** Obtain one unpatterned Blue and Gold Blank

**8.6.3** Load centura in following arrangement

**8.6.3.1** Slot 2: P-type Test dummy wafer

**8.6.3.2** Slot 3: Unpatterned Blue and Gold Blank

**8.6.3.3** Slots 4-8: Patterned Blue and Gold Blank

**8.6.4** Run 10 minute O2 MXP CLEAN recipe on dummy wafer to clean chamber

**8.6.5** Run MXP-NITRIDE-ETCH on Unpatterned Blue and Gold Blank with a time of 60 seconds

**8.6.5.1** When the endpoint system indicates a notable signal drop, end the etch manually (see centura-mxp manual)

**8.6.6** Run MXP-NITRIDE-ETCH on a patterned blue and gold blank wafer

**8.6.6.1** When the endpoint system indicates a notable signal drop, end the etch manually (see centura-mxp manual)

**8.6.6.2** Move wafer to flat finder to check visual contrast.

**8.6.7** Repeat above steps and modify endpoint timing as necessary to create visually appealing wafer.

**8.7** Resist Strip

**8.7.1** Strip resist in matrix for 2:30.

## *9.0 Troubleshooting Guidelines*

**9.1** Furnace Steps

**9.1.1** Problem: The color of the film is not correct

**9.1.2** Solution: Check deposition thickness and correct processing time appropriately

**9.2** Photolithography steps

**9.2.1** Problem: Mask pattern is not resolving properly

**9.2.2** Solution: Examine mask under microscope with mask designer and determine if greyscale resolution needs adjustment

**9.3** Etch Steps

**9.3.1** Problem: Cannot resolve endpoint detection

**9.3.2** Cause: Endpoint needs one wafer dummy run between cleaning and actual run to allow for seasoning of chamber. Try additional wafer, then contact process staff for assistance.

## *10.0 Figures & Schematics*

## *11.0 Appendices*