

## MEMORANDUM

To: Katalin Voros, Operations Manager  
From: **Marilyn Kushner**, Junior Development Engineer  
Cc: Sia Parsa, Process Supervisor  
Subject: 2009 Year-End Report  
Date: 22 January 2009

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### I. SEMICONDUCTOR PROCESSING

The photolithography equipment used in processing that are under my direct involvement are: the GCA Wafer Stepper(6) the GCA Pattern Generator, the Ultratech Mask Copier and the ASML. Additional equipment in this group includes the APT chrome and emulsion mask developers, and the 4" and 6" tracks for coating and developing wafers.

#### **GCA Pattern Generator**

The online mask-making form for mask-making requests is utilized by all lab members submitting a mask request, as well as other university affiliated researchers and BMLA lab members.

Mask-making requests are accepted for both the GCA Wafer Steppers (gcaws2 and gcaws6), the Quintel contact printer, the Karl Suss contact aligner, and the Canon 4:1 reduction printer. Requests are also accepted for the advanced lithography ASML stepper.

The pattern generator continues to be utilized on a daily basis by myself and the select group of lab members who are carefully trained and then qualified to operate it. A total of 643 completed photomasks were logged into the gcapg log book by the end of the calendar year, December 31<sup>st</sup>. Note: Although the yearend mask total dropped a bit and leveled off, just before the holidays there was a surge of mask requests that was interrupted by the aftermath of the VLSI fire by the pattern generator's power supply shorting out due to the cables being damaged by water on the floor from when the sprinklers went off. It took six weeks to source a new power supply for this tool.

The decrease in mask-making requests again was largely caused by out-sourcing to Photo Sciences, Inc. and Toppan Photomasks; the latter is contracted to make photomasks for the CMOS baseline process as mask geometries less than two microns are below our machine capability and/or resolution. There is, however, a silver lining to this: I was able to execute speedy mask-making turnaround times on a consistent basis- frequently same-day service.

#### **Inter-University Cooperation**

Former Microlab lab members who are now faculty within the UC system And beyond continue to be tremendously loyal and supportive of the Microlab's mask-making facilities and refer our services to research groups within their own university systems; this group continues to grow as many former lab members are now faculty elsewhere throughout the United States and continue to support the mask-making facilities in the Microlab.

#### **New for 2009:**

##### **University of Texas@ Austin**

Navid Ghorashian

##### **Korea Advanced Institute of Science and Technology (KAIST)**

Professor Inkyu Park

Dept. of Mechanical Engineering

## **Ongoing:**

### **University of Maryland**

Center for Superconductivity  
Material Research Science and Engineering Center  
Maryland MEMS lab  
Department of Mechanical Engineering/Institute for Systems Research  
Department of Aerospace Engineering  
Nanoelectronics Research Group

### **Caltech**

Blake Axelrod  
Condensed Matter Physics

### **University of Michigan**

Professor Nicholas Chronis  
Department of Mechanical Engineering

## **II. PROCESS MAINTENANCE**

### **GCA Pattern Generator**

The GCA Pattern Generator as scheduled monthly maintenance tasks that are performed on a routine basis. Such as: the mercury lamp change every 750+ hours (followed by focus/exposure tests for chrome and iron oxide after the lamp has burned in for 24 hrs.) Emulsion focus/exposure tests are done on a "as needed" basis; the same goes for iron oxide masks. Other tests for the pattern generator are the angles and alignment test, which is performed monthly on both chrome and emulsion plates, and the stage motion tolerance test which compares two different tolerances. By strictly adhering to a six-month major maintenance call to RZ Associates for stage maintenance, machine uptime for this tool continues to be superb.

### **GCA Wafer Stepper 6-inch tool (gcaws6)**

The gcaws6 has a scheduled mercury arc lamp change at 2500+ hours; this is performed by Evan Stateler. After a 24-hour lamp burn-in, a new focus/exposure test is performed to determine the best focus and exposure time. The standard baseline correction and micro-dfas baseline correction are performed once per week and on request by lab members with extreme critical alignment.

### **ASML Stepper (asml)**

IOC tests and illumination uniformity are performed three times a week, essentially after the laser refill.

### **Karl Suss Contact Aligner**

The lamp intensity is measured at five points on a weekly basis using the Karl Suss UV Intensity Meter. Measurements are taken for both I-line and G-line and recorded in a logbook kept by the tool and then posted online.

### **Microlab Annual Clean Fest**

The Microlab Clean Fest this fall was cancelled due to the migration to the new Marvell Nanolab and the downsizing of the Microlab operations in general. It will be rescheduled sometime in the spring of 2010.

## **Summer Interns**

As usual, I chaperoned our two summer interns on the annual field trip to Semicon West at the Moscone Center in San Francisco.

## **III. SPECIAL PROJECTS**

### **Critical Point Dryer**

Conducted a CPD particle test at the critical point dryer to compare the particle count of the standard lab techni-cloths vs. Valuseal polyester cloths.

Wafers were checked out of inventory and piranha cleaned at sink6, rinsed, 10:1 HF dipped, then rinsed again and dried in the spindryer. Next, the entire CPD area (including the tabletop surface) was wiped down with the Novaclean lab cleaner and the inside of the chamber was wiped down with the polyester Valuseals. A test run was performed and the wafers inspected under white light at a microscope. A second test run was done with the CPD being wiped down with techni-cloths. This experiment showed the Valuseals decreased the particle count considerably and are now stocked at the CPD.

### **Wafer Preparation for RZ Enterprises**

Reworked 6" wafers for Dick Ziegler for his in-house testing. Wafers were first stripped at the Matrix then piranha-cleaned at sink8, primed in the primeoven, then coated with the OCG825 g-line photoresist.

### **Pocket Wafers**

Kin Chan and I worked as a team to prepare fifty pocket wafers for labmembers to use on 6" equipment but when their process requires 4" wafers.

### **ETR for Washington University (St. Louis, MO.)**

Former labmember Yan-Mei Wang- now faculty at Washington University- sent one box of 6" fused silica wafers to be RCA-1 and RCA-2 cleaned in the VLSI area.

### **Staff Photography**

The "Good News" photo display case located midway down the main hallway outside the Microlab is also maintained by myself; even though the Microlab has gone digital, labmembers still like to see themselves on film and I give them the double print! I recently added a display of life inside the Marvell Nanolab, highlighting all the bright and clean and shiny wetsinks.

### **Microlab Annual Summer Barbecue**

This year I again chaired the barbecue committee in general and was aided by several co-chairs: Madeleine Leullier for the publicity poster; Joe Donnelly for all-around assistance, and other staff members stepped up to volunteer for the Picnic site setup, the grilling, the organized sports, and the final cleanup. This year we had something new: ice cream made on the spot with liquid nitrogen! This was really popular with the kids and showed them how science really can be fun. Our Microlab Operations Manager, Katalin Voros, generously sponsored this picnic at her local neighborhood "Orinda Oaks Park" .

## **IV. TRAINING & ADVISING**

### **Training Processtaff**

This past year I trained our MEMS exchange engineer, Xin Gao, on several pieces of the photolithography equipment as well as familiarized him with the basic wetsink operations.

I also trained Professor Clark Nyugen's processing staffperson, Zeying Ren, on the photolithography tools.

### **Training and Supervising Student Staff**

The student staff position that was created to keep the coffee room, Microlab lobby and the Microlab in general looking presentable continues to work out well; this student employee, under my general supervision, works with a high level of independence and manages this job quite well; tasks are added as the need arises. I also supervise the student staff that stocks chemicals and lab supplies for the Microlab and packages up chemical waste for pickup by EH&S. A second student staff employee was added after the holidays to stock materials for the Nanolab.

### **Training Graduate Student Microlab Members**

The major photolithography equipment (the GCA Wafer Stepper and the GCA Pattern Generator) continue to be among the most heavily used pieces of equipment in the Microlab. For both pieces of this equipment lab members tend to train each other, but I continue to grade the written tests and conduct the oral exams.

### **Safety Training & Advising**

Following the Microlab Orientation course and lab tour, each new lab member is required to take the Microlab Orientation Safety Test. The questions from this test are from the orientation, safety video, lab tour and orientation handouts.

### **Microlab Suggestion Box**

The Microlab suggestion box (located in the main Microlab hallway) is checked periodically for new safety suggestions submitted by lab members. The items brought up are discussed with the Microlab manager. To date, the submissions continue to be excellent and I work with our safety manager to implement them as soon as possible; the suggestions and improvements are posted online for reference.

### **Facilitating the Move to the Marvell Nanolab**

At our weekly processtaff group meetings, contributed input on various Nanolab equipment and operations necessary to make this transitional move as smooth as possible, from materials needed in the new lab immediately to facilitate processing, to evaluating the new pattern generator room lighting for sufficient darkness.

## **V. COMPUTER REPORTS & DOCUMENTATION**

Online equipment manuals need to be revised and/or updated periodically to reflect changes in processing and/or procedures as well as to integrate suggestions and ideas from labmembers. The following chapters have been updated or revised this year:

February 2009:

Chapter 3.3 - GCA Pattern Generator (gcapg)

Section 8.4: Added the command "TQ" (test queue) which tests the job data in the mask queue for data errors in the mask file.

Section 9.14: Specified that at the >> prompt to type "TQ" to test the job(s) in the user's mask queue for data and format errors.

#### Chapter 4.29 - HMDS (primeoven)

Added two minor corrections: specified sink4 with its recessed HMDS tank as the backup for when the primeoven is down and also noted that the oven door gasket should be checked for cracks before latching the door.

November 2009:

#### Chapter 4.25 - SVGDEV (4" photoresist Developer Track)

Section 8.0: Replaced the word "three" with the word "two" to describe how many different types of developers are used at this tool.

#### Chapter 3.7 - MASKCOPY (Ultratech Mask copier)

Section 3.0 (Scope): Updated the scope to note that only 5" mask plates can be copied at this tool.

Section 8.11: Deleted the chart for copying 2.5" plates.

Section 9.2.1: Deleted reference to changing the maskcopy door and noting only that the door needs to be securely seated before use.

#### Chapter 3.4 - APTMUL (APT Emulsion Mask Developer)

Section 6.0 (Safety): Added the process note not to run the chemicals in the bottles down to the last drop.

Section 9.1.4: Added sentence where to find the techni-cloths in R1.

Section 9.1.5: Added note that the rapid fixer tank level in the service chase is regularly checked by staff via a "pmstat" notification.

Section 9.2.5: Added the instruction to equipment users that they are to dump, rinse, and then refill the water beakers underneath the tool if the water is discolored or has particles in it.

#### Chapter 3.5 - APTCHROME (APT Chrome Mask Developer)

Section 9.0 (Equipment Operation): Noted that if you try to run two programs at the same time, the system will wait for you to deselect one of the programs first.

Section 9.2 (Checking Chemical Lines): Added the sentence that if the chemical being dispensed is spraying in a thin stream rather than in a fan-shaped spray, it means the nozzle is clogged and needs to be replaced and should be reported promptly on FAULTS.

Section 9.3.8: Added sentence where the techni-cloths can be found in R1.

#### Chapter 3.6 - IRON OXIDE MASK PROCESSING

Section 3.0 (Scope): Noted that photoresist gets stripped from the mask as a final step.

Section 9.1.4 - Added information that if more than one recipe is selected, the system will wait for you to deselect one of them before running the recipe.

Section 9.2 (Checking Chemical Lines): Added the sentence that is the chemical being dispensed is spraying out in a thin stream, the nozzle needs to be replaced and should be reported promptly of FAULTS.

Section 9.2.5: Added where to find the techni-cloths in R1.

#### Chapter 4.12 - GCAWS6 (GCA 6" Wafer Stepper)

Section 8.0 (Process Notes): Noted that only 5" chrome photomasks are allowed to be used at this tool as emulsion masks are not compatible with I-line wave lengths.

### **Annual Short Safety Quiz**

Contributed several multiple-choice questions for the updated version of this quiz.

### **Lab Protocols**

Using Bill Flounders first draft as a guide, updated the basic lab protocols section for the lab orientation handout.

### **Microlab Lab Orientation Lab Etiquette**

Orientation notes updated and expanded to make this section more relevant to current lab practices.

### **Microlab Blue Process ID Forms**

Attila Horvath and I collaborated to update and slightly revise the blue process ID forms posted throughout the Microlab, especially at the wetsink stations. We also prepared a new set for the Marvell Nanolab.

## **VI. SPECIAL AWARDS**

This summer I was delighted to receive another "SPOT" award from the department in the category of collaboration, inclusion, initiative and service.

My student employee, Greg Michael (whom I nominated for service) was also selected for a "SPOT" award as well.