Chapter 4.35

ASAP-Liftoff

(asap-liftoff) ***(582A)***

1.0 Equipment Purpose

1.1 The ASAP Liftoff system uses a spray of NMP and IPA to strip resist and perform liftoff of metal and dielectric films on samples ranging in size from 6-inch wafers to 1 x 1 cm^2 chips.

2.0 Material Controls & Compatibility

2.1 This system accepts standard semiconductor materials. Contact Staff for review of your process before use.

2.2 Heated soak is intended for wafers, no chips are allowed to use the standard soak recipes. See staff if you would like special permission to use the heated soak on a chip

2.3 Do not run recipes on small substrates that were written for larger substrates (ex: a 150mm recipe on a 100mm wafer). See staff if you need a recipe modification to accommodate your substrate size.

3.0 Training Procedure & Applicable Documents

3.1 Basic Tool: this tool requires enabling and a formal qualification session, but does not have an online test.

3.1.1 Timeline (estimated time to completion: 1-2 days)

3.1.1.1 Get trained by any qualified member.

3.1.1.2 Arrange a qualification session with a superuser to show competency on the tool.

3.1.1.3 Superusers and staff qualify members on this tool. Superusers on this tool may have permission to do advanced techniques

3.2 Nanolab Process Acceptance Summary: ASAP Liftoff 6100: https://docs.google.com/document/d/1OurCcMEBKrs0AVgJVTF7dOo-B1JK6QSEsa228vQ7fMo/edit?usp=sharing

4.0 Definitions & Process Terminology

4.1 Carboy - a plastic container used for collecting process waste.

4.2 *N*-Methyl-2-pyrrolidone (NMP) - a solvent used for efficient and complete removal of PMGI, PMMA, SU-8, and other resist films on Si, SiO2, GaAs, and many other substrate surfaces. It is commonly used as a lift-off solvent.

5.0 Safety

5.1 Follow general safety guidelines for the lab; the safety rules outlined in Chapter 1.01 - Marvell NanoLab Chemical Hygiene Plan and the following:

5.2 Chemical

5.2.1 This system uses NMP. Review according MSDS before using.

5.2.2 This system has pressurized canisters. Only approved personnel may refill these.

5.3 Mechanical

5.3.1 Moving parts including a rotating chuck and robotic spray heads. Stay clear of all moving parts when operating this system.

5.4 Electrical

5.4.1 Stay clear of mains power.

5.5 Cleaning the nozzle shroud

5.5.1 If you want to clean the nozzle shroud yourself, you must:

a) Have a wafer on the chuck protecting the vacuum lines from liquid

b) Been instructed by staff on how to do so properly, within the raised cup

5.5.2 You can report a fault that the nozzle requires cleaning if it is really full of large flakes of metal. Do not spray water onto the nozzle unless you have followed the proper steps. Spraying water outside the cup could set off the water sensor alarms and could put the tool on hold for hours.

5.6 Tool Precaution

5.6.1 Report when large waste carboy is 80% full, **and** no empty spare is available.

5.6.2 Do not leave the heater on.

5.6.3 Rinse bowl of metal particulates with provided spray bottle. Use tech-wipes if necessary.

5.6.4 Recipe management - Use recipes 1 - 12. Contact Staff if a custom recipe is needed.

5.6.5 All recipes must have an IPA frontside rinse step.

6.0 Process Data

6.1 Nanolab Process Acceptance Summary: ASAP Liftoff 6100: https://docs.google.com/document/d/1OurCcMEBKrs0AVgJVTF7dOo-B1JK6QSEsa228vQ7fMo/edit?usp=sharing

7.0 Available Processes, Gases, Process Notes

7.1 Refer to Appendix 11.1 for a table of available recipes.

7.2 Heated NMP is available in puddle dispense only. The spray dispense is at room temperature only. NMP Heater must be turned on 30 minutes before processing to allow temperature to stabilize. See section 8 for more information.

8.0 Equipment Operation

8.1 Wafer Placement

8.1.1 Select the appropriate sized chuck for your wafer and install on the spindle. Ensure that the chuck is fully inserted by rotating the chuck by hand and ensuring the whole system rotates.

8.2 Recipe Select

8.2.1 From the main menu, select Automatic operation. In the automatic operation menu, press the two digit number located next to “Recipe No.” This will allow you to select the desired recipe from the pre-designed recipe list displayed in *Table 1,* and directly under the touchscreen. If you have worked with a nanolab process engineer to design a custom recipe, enter that recipe number here.

8.2.2 For a **heated soak**: turn on the heater and wait 10-15 minutes for the temperature to stabilize. Before your first wafer, turn off the heater for 2 minutes. After the first soak dispense, turn the heater back on and leave it on for the rest of your run.

8.3 Loading the Wafer

8.3.1 Place the wafer on the chuck using the white wafer mounter. Ensure that the wafer tray does not bump the wafer when pulling it out, and ensure that the wafer is centered. Gently close the doors, the system is interlocked and will not run with the doors open.

8.3.1.1 **For pieces**: Inspect chip/piece adapter and backside of any piece for cleanliness. Both the chuck surface and backside surface should be clean and free from any residue for good vacuum. Place chip/piece adapter on top of **original large chuck**. Do not use the small chuck. Using the mirror, verify the adapter is in line with the original chuck line for vacuum (the holes line up). Place the piece as center as possible.

8.4 Running the Recipe

8.4.1 Press “origin return” on the panel to enable the chuck vacuum and initialize the system. This must be done each time a wafer is set on the chuck.

8.4.2 Press the “Start button” to commence liftoff.

8.5 Removing the Wafer

8.5.1 When the process has completed, the wafer will stop spinning and the cup will be lowered presenting your wafer for removal. You may then open the doors and safely remove the wafer.

8.5.1.1 **For pieces**: Wipe down chuck after each use, and back side of pieces if needed.

8.6 Ending Your Session

8.6.1 Turn off the heater if you use it.

8.6.2 Verify the chuck is clean (not wet). Wipe down if necessary. This helps minimize the chance of vacuum errors.

8.6.3 Check the waste carboys: the one at the front of the tool should weigh less than 9 lbs, the one in the chase behind the tool should be less than 80% full. See the appendix for detailed instruction about checking and changing the waste carboys.

9.0 Troubleshooting Guidelines

9.1 If an alarm comes in, press “Menu” at the top left to go to the main menu. Press “Alarm” to see what has caused the alarm, and silence the buzzer. If the fault is due to a simple error, such as a door being left open, correct the error then ***select the fault*** in the scroll menu and press “RESET”. You will be unable to clear the alarm unless the problem is fixed. For anything that cannot be corrected from the outside of the machine, put in a problem report or contact a staff member immediately.

9.1.1 Frequent Alarms:

In Cup Wafer Chucking Alarm: This alarm comes in when the vacuum seal that holds the wafer to the chuck is sensed to be too low. The system will stop the chuck immediately to prevent the wafer from being thrown. The typical cause of this is debris on the back of a wafer. Simply reset the alarm (described above) and clean the back of the wafer.

Low Pressure Limit Abnormal: This is a spurious error caused after the tool sits for an extended period. The pressure downstream of the HP Pump drifts down, and when a recipe is started the NMP expelled from the nozzle quickly brings the pressure below the setpoint before the HP pump can boost it back up. A reset of this alarm and restarting the recipe will always fix this. Clearing the alarm requires an extra step; Go to “Main Menu”, press “Chemical Operation”, next to “HP Pump” select “OFF”. You can then proceed to the alarm page and clear the alarm by selecting it and present RESET. The recipe will proceed and you need to immediately go and turn the HP pump on from the Chemical Operation window.

NOTE: If wafer is stuck on the chuck with vacuum on and you want to remove it, proceed to press EMG stop button (NOT EMERGENCY STOP!) followed by Origin Return. If not sure about this procedure, get process staff help.

Heater Alarm: This alarm comes on if you are using one of the heated NMP soak recipes and have not warmed the liquid for enough time to let it stabilize, or if the liquid gets too hot. If the. Wait till the temperature is within the limits +/- 5deg from 80°C to reset the alarm and wait till it’s stable. To avoid triggering the overtemp alarm, turn off the heater for ~2 minutes before running your first wafer. After starting the first wafer, turn the heater back on.

9.2 **Small plastic O-ring on chip adapter chuck stuck to sample. Rubber-like seal is resistant to NMP, but glue that holds it on is not.** Please rinse the chip holder and seal with D I water after each use to keep the NMP from seeping under the seal. Do not put the seal upside down, the glue side which is shiny should face down.

9.3 **Vacuum not working for small pieces**: Remove piece from chuck, wipe down chuck (technicloth and small amount of IPA) and back side of piece. Reset any alarm before trying again. If the problem persists, put in a problem report.

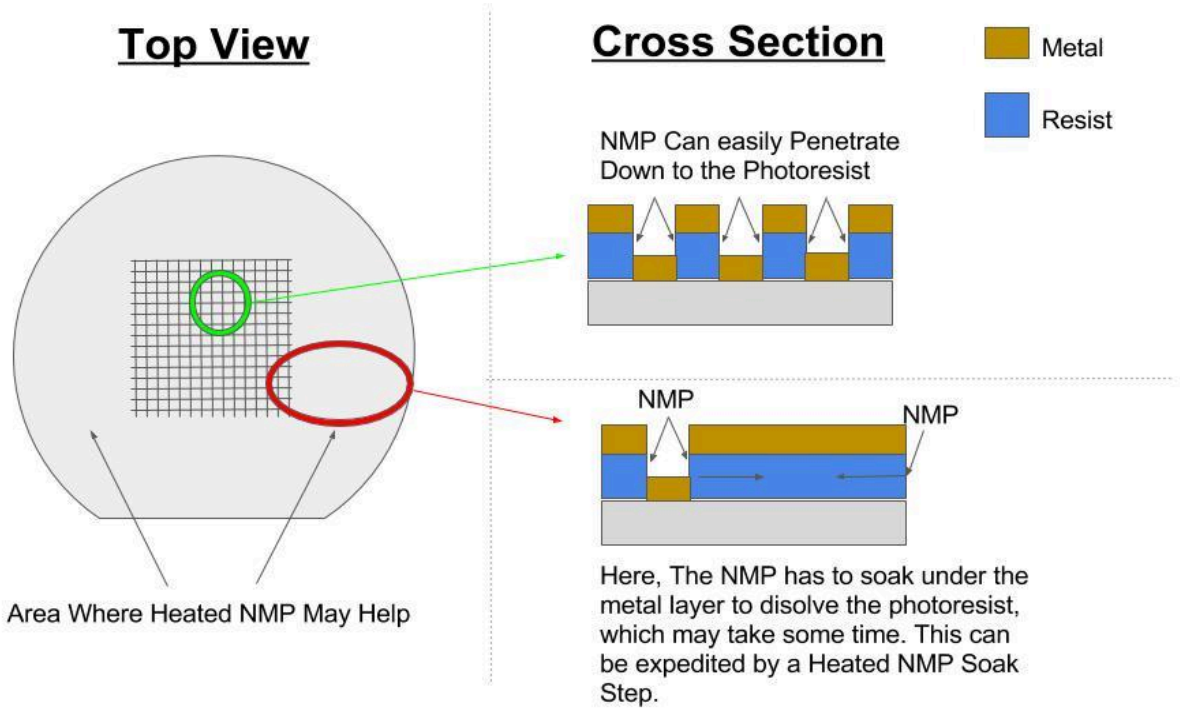
10.0 Study Guide

10.1 There is no exam for this tool. Here are suggested questions for the oral qualification:

- **10.1.1** Review of standard process recipes
- **10.1.2** Heater operation
- **10.1.3** Rinsing bowl with water
- **10.1.4** How to empty out the waste into the carboy and how to switch the filled waste carboy

11.0 Appendices, Figures & Schematics

11.1 Heated NMP Soak Utility



11.2 Table of Standard recipes

Recipe	Substrate (mm)	Rotation (rpm)	Time (sec)	Soak (Y/N)	Nozzle	Pressure (MPa)	LIftoff Intensity
1	150	1000	120	N	HP2	8	Very Low
2	150	1000	180	N	HP2	10	Low
3	150	1000	120	N	HP2	15	Med
4	150	1000	180	N	HP2	15	High
5	150	1000	150	N	HP2	20	Very High
6	100	1000	90	N	HP2	8	Very Low
7	100	1000	135	N	HP2	10	Low
8	100	1000	90	N	HP2	15	Med
9	100	1000	135	N	HP2	15	High
10	100	1000	115	N	HP2	20	Very High

11	20	1000	60	N	HP2	15	Med
12	20	1000	120	N	HP2	15	High
13	150	1000	120	Y	HP2	8	Very Low
14	150	1000	180	Y	HP2	10	Low
15	150	1000	120	Y	HP2	15	Med
16	150	1000	180	Y	HP2	15	High
17	150	1000	150	Y	HP2	20	Very High
18	100	1000	90	Y	HP2	8	Very Low
19	100	1000	135	Y	HP2	10	Low
20	100	1000	90	Y	HP2	15	Med
21	100	1000	135	Y	HP2	15	High
22	100	1000	115	Y	HP2	20	Very High
23	150	0	120	Y	HP2	0	Soak Only

Note: Process parameters listed above are for the main liftoff step that is part of a broader recipe.
Warning: If lifting off chips and chip does not cover the entire seal, do not use the recipes above. Contact PE 1 to review your process.

11.3 Transferring Waste from Small Carboy to Large

11.3.1 Check the weight of the small carboy in front of the tool, if it reaches 9lbs it must be emptied.

11.3.2 Go to the chase and check the large carboy. If the carboy is 80% or more full, you must replace it with a new one. Put on the appropriate PPE: apron, face field, and chemically resistant gloves. Locate an empty carboy (there should be an empty one next to the full one), and make sure it is placed in a yellow secondary containment bin. Lift the pump handle from the full carboy but do not move it right away! Keep the pump handle over the carboy until it has finished dripping, then transfer it to the new empty carboy.

11.3.3 Locate the pump's foot switch — Press the foot-switch with your foot, and squeeze the pump handle to empty the small front carboy into the larger carboy. If you did not start a new large carboy, keep an eye on the liquid level and make sure you do not overfill the large carboy.

11.3.4 Make sure you clean up any spills or drips when you are finished.

11.4 Suggestion for liftoff using e-beam resist PMMA

When depositing films on top of PMMA, a "blistered" texture may form in the film. This thread offers suggestions to avoid deposited film blistering, such as increasing the distance between source and sample, avoid carbon contamination of the crucible (avoid "Fabmate" crucible liners for gold), deflecting electrons away from the sample during deposition using electrostatic or magnetic method, and increasing the deposition rate.

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