CORAL Name: DRIE-STS-Pegasus

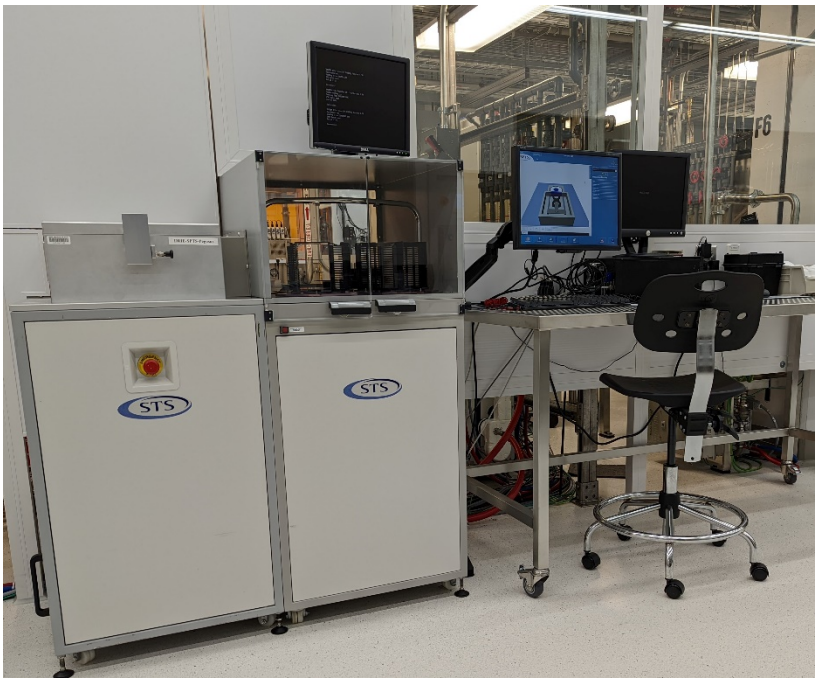
Location: 7U
Tool Category: DRIE
Contacts: Donal Jamieson and Dennis Ward

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Introduction

The ST Systems Multiplex ICP tool (Model: STS Pegasus ICP DRIE) is a Deep Reactive Ion Etch (DRIE) tool. Utilizing the Bosch Process, it can etch high aspect ratio, anisotropic trenches deep into silicon and even through a 6" wafer. The tool uses two independent 13.56MHz Radio Frequency (RF) power supplies; inductive power coupling of the coil to the plasma creates high density plasma which results in high etch rates. The Bosch Process alternates between an etch cycle flowing only SF_6 gas and a passivation cycle using C_4F_8 gas to deposit a polymer layer. The directional etch cycle preferentially removes the passivation polymer from the bottom of the trenches leaving the sidewall film intact to prevent features from widening; as the cycle is repeated over and over a high aspect ratio trench is formed.



This system has an integrated End Point Detector (EPD) that looks at the etch byproduct spectrum to monitor and accurately end the etch when reaching a buried layer. An additional pulsed low frequency RF power can prevent 'footing' (lateral etching) when reaching a conductive buried layer such as a buried oxide on SOI.

The process in this tool is very specific – only single 6" Silicon wafers will successfully etch. The system can run 2 wafers sequentially if loaded in the carousel.

Safety

The EMO for this system is located on the left front of the tool. Do not try to defeat any interlock on the system. This system utilizes RF radiation, high voltage electricity and compressed gases. The plasma generated during deposition radiates UV, it is blocked by the chamber viewport material but users should not spend much time viewing the plasma. Keep your hands away from all moving parts and be aware of the loadlock lid as a pinch point. Be sure that all covers are in place when you are processing. If you encounter any equipment problems while operating the system, contact the technical staff in charge of the system - do not try repairs on your own.

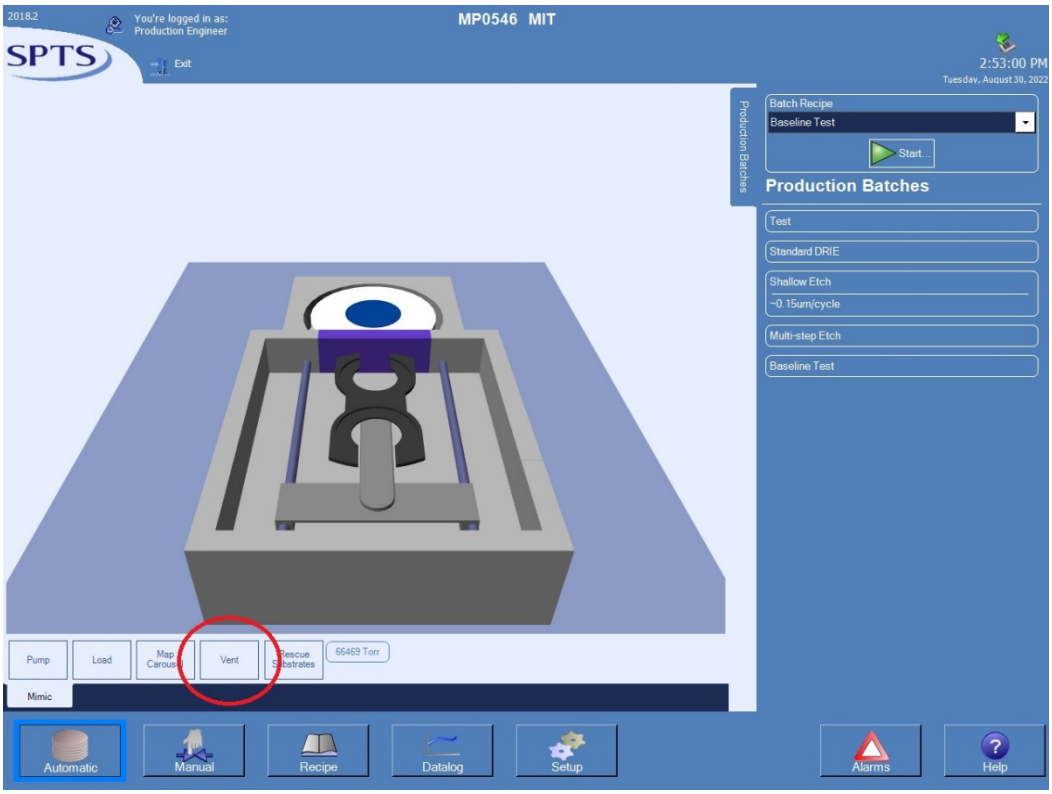
User Qualifications and Responsibilities

It is the Users responsibility to report any issues with the system in CORAL.

Operating Procedures

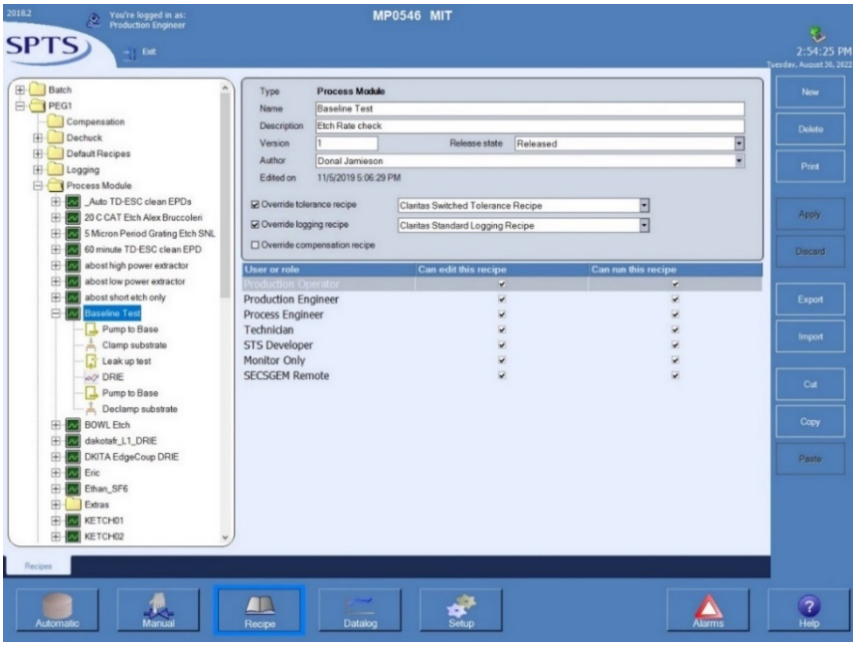
Loading a Sample:

1. Make a reservation in Coral with sufficient time to complete the etch.
2. Engage the system in Coral.
3. If the carousel is under vacuum, vent the loadlock by clicking on the **Vent** button underneath the image of the carousel.
4. Open the Carousel lid and place your wafer in one of the slots.
5. Close the lid and set the latch to keep the lid closed during the pump down step.



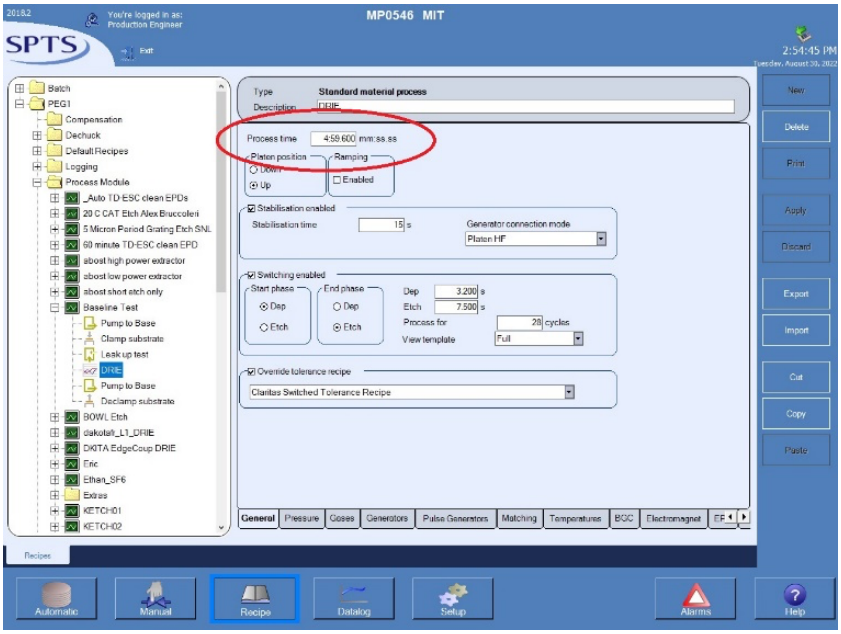
Editing a Recipe:

1. Click on the **Recipe** button in the bottom center of the screen. Then expand the folder tree to go to **PEG1 -> Process Module.**



2. Every recipe will contain necessary steps such as ‘Pump to Base’, Clamp Substrate’, leak up test’, the process step, ‘Pump to Base’ and ‘Declamp substrate’.

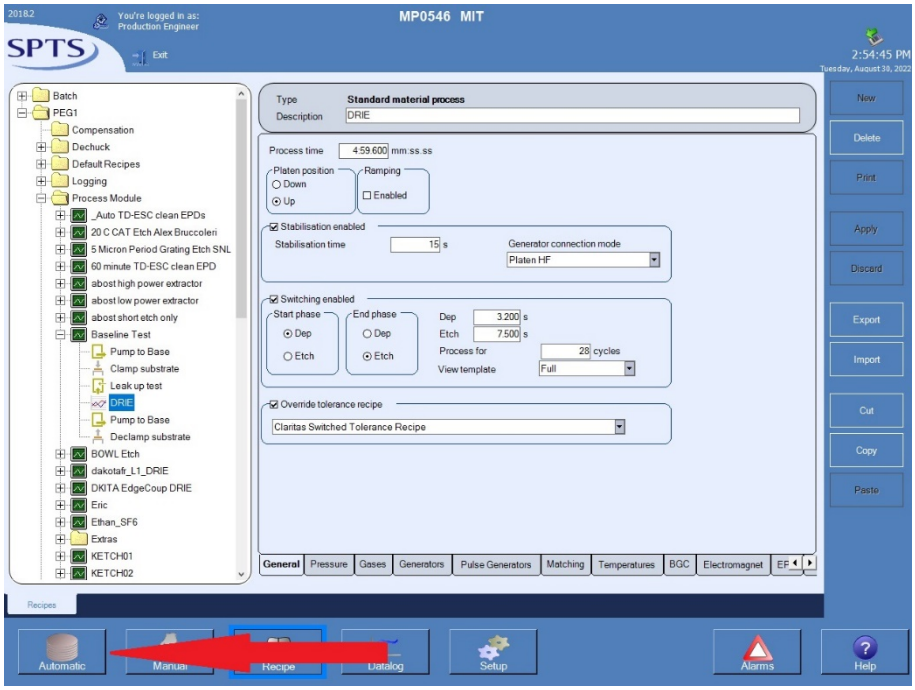
3. Click on the Etch step of the recipe and adjust the **Process Time** or number of cycles to adjust recipe to achieve the desired etch depth. This should be the only parameter adjusted in the recipe. Custom recipes can be developed with assistance from staff.



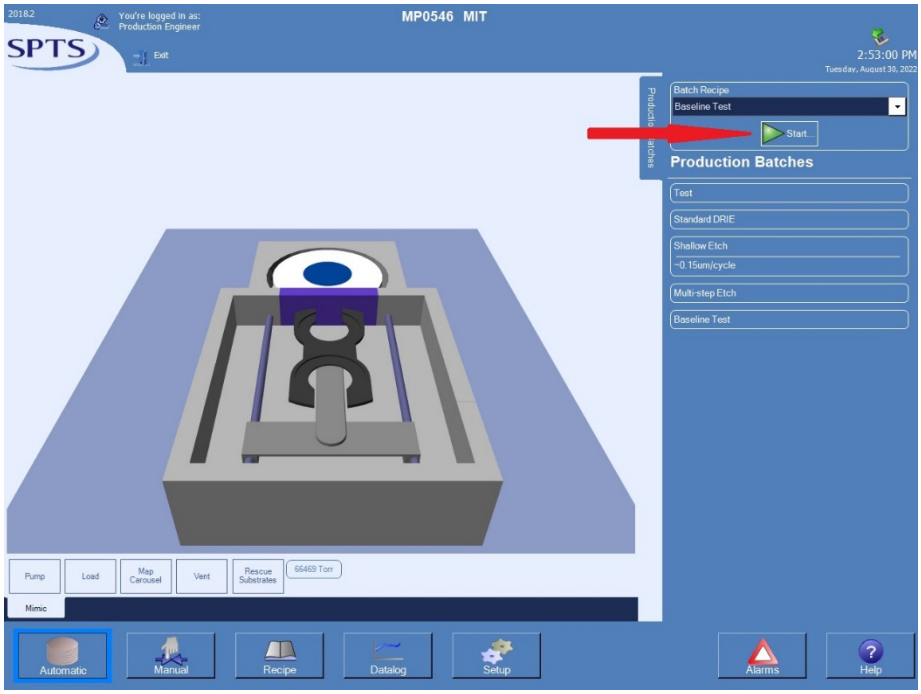
4. Save the change by clicking on the **Apply** button on the right-hand side of the screen.

Processing the Sample:

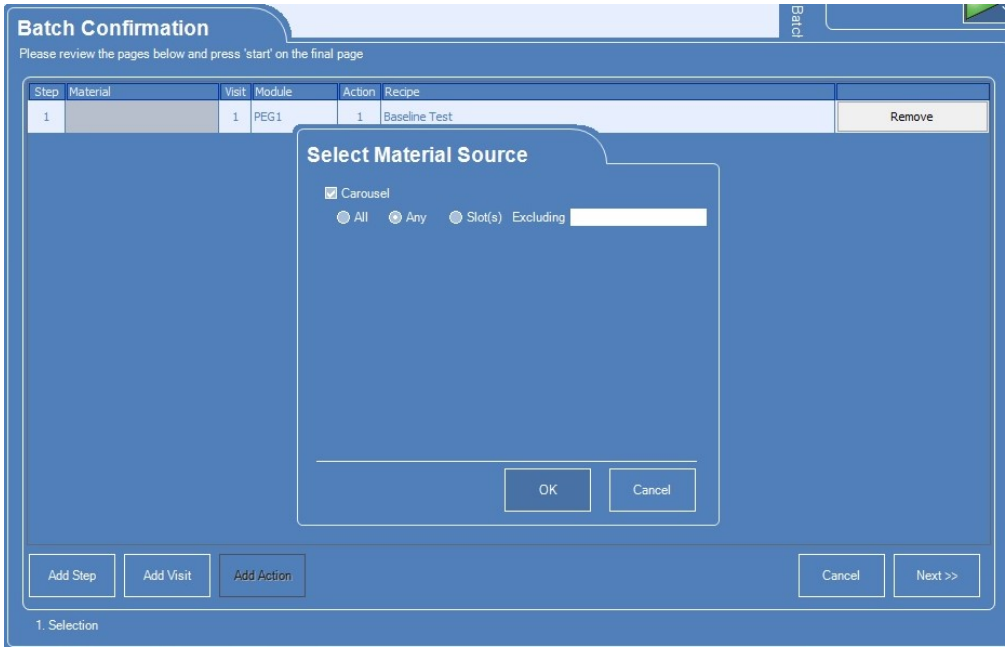
1. Click on the **Automatic** button on the bottom left of the screen to return to the main screen.



2. Click on the **Start** button, then click on the Material box on Step 1 of the resulting window. This is so we can tell the system where the wafers are likely to be.

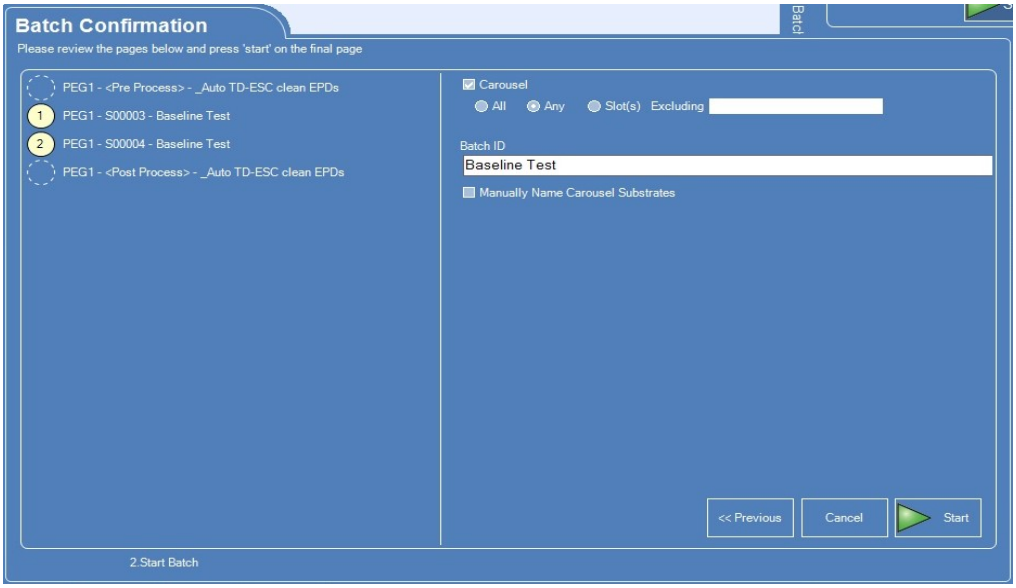


3. Select Carousel then click on the **Any** box in the pop-up window, then click **OK**. This allows the system to run the same recipe on every wafer it detects in the carousel. We can also run different recipes on different wafers by choosing specific slots.



4. Click on the Recipe name box to choose your desired recipe from the list.

5. Click **Next>>** which brings you to a summary page of what steps will occur during the entire process run on the system.



6. Press **Start** to begin the process run.

7. When the process has completed the wafer will be returned to the carousel which will vent to atmosphere.

8. Remove your wafer from the carousel and disengage the system in Coral.

Appendices

Bosch process descriptions:

https://en.wikipedia.org/wiki/Deep_reactive-ion_etching
https://www.azom.com/article.aspx?ArticleID=18694
https://www.youtube.com/watch?v=6Wva2a_4IA4

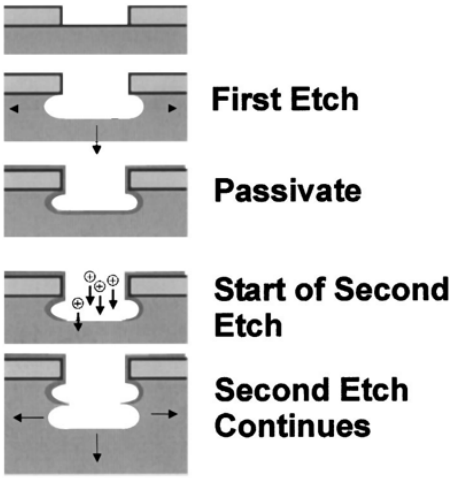


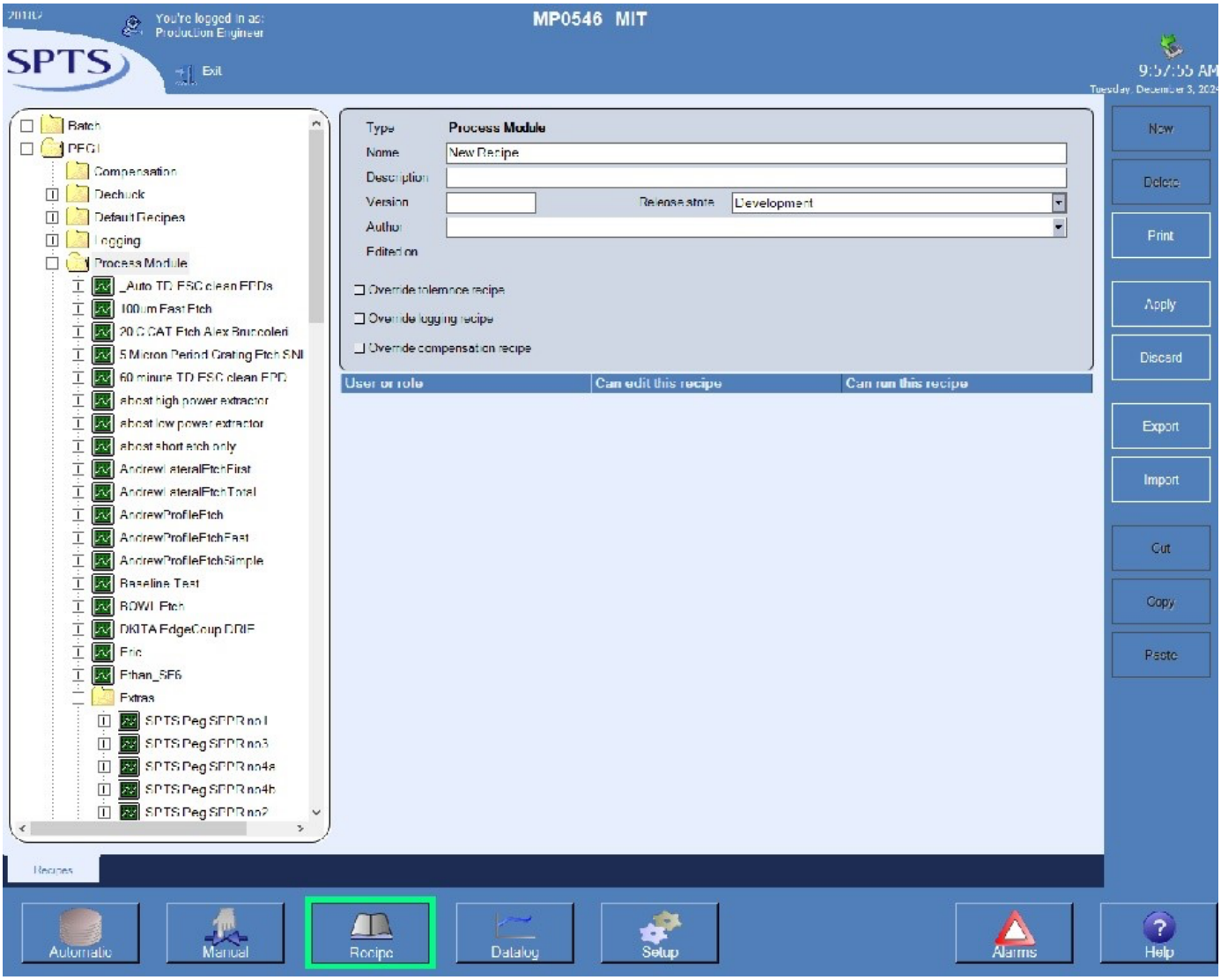
Image Credit: Craigie, C. & Sheehan, T & Johnson, V. & Burkett, Susan & Moll, Amy & Knowlton, Bill. (2002). Polymer thickness effects on Bosch etch profiles. Journal of Vacuum Science & Technology B: Microelectronics and Nanometer Structures. 20. 10.1116/1.1515910.

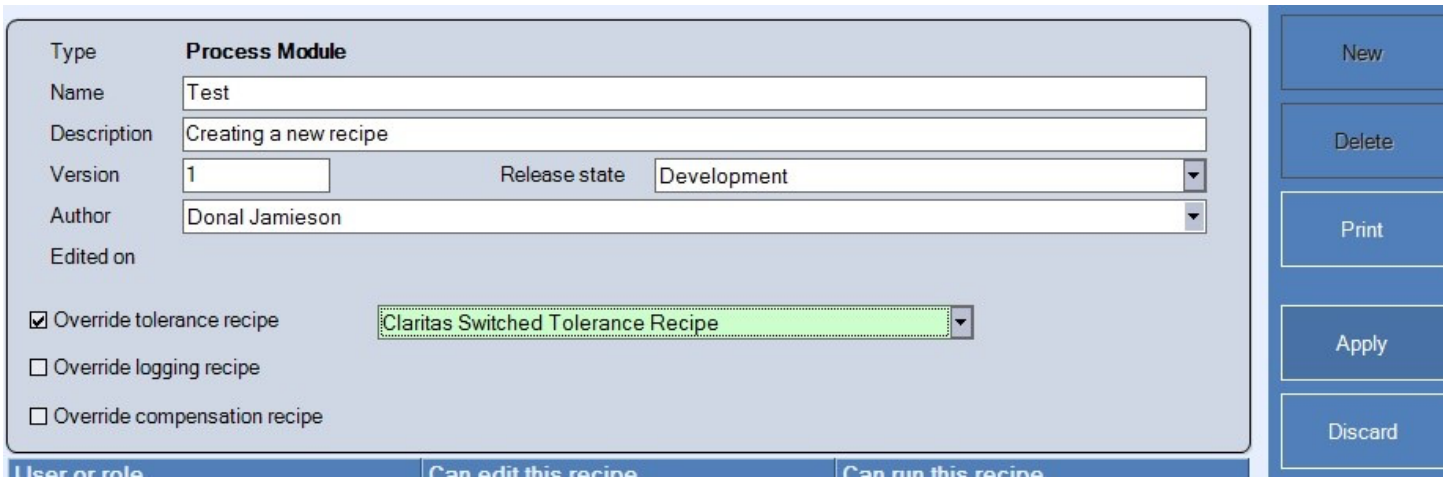
Creating a Recipe:

Open the Recipe Editor and click on ***New***:

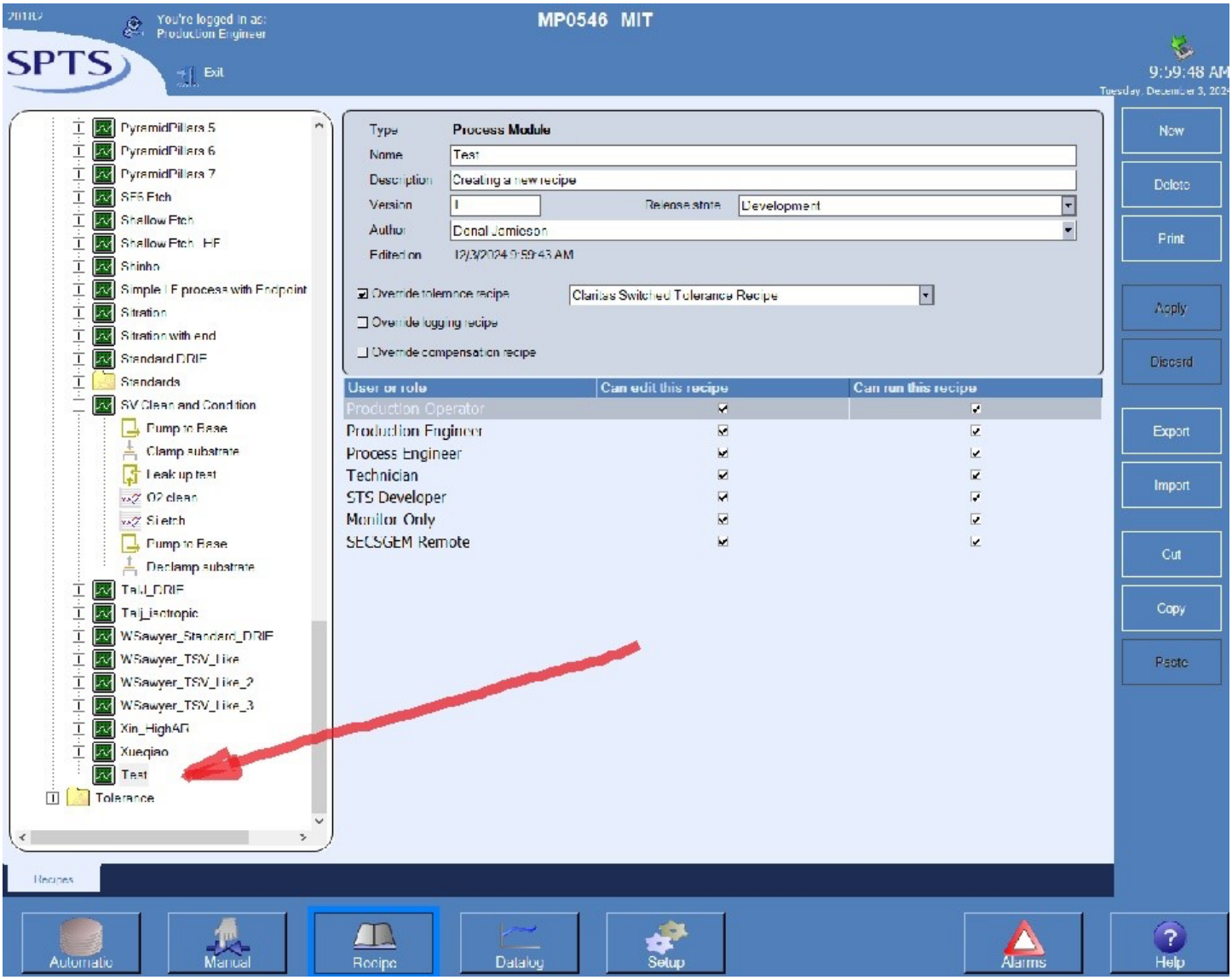


The Recipe header editor will open, fill out the relevant information and click ***Apply***:





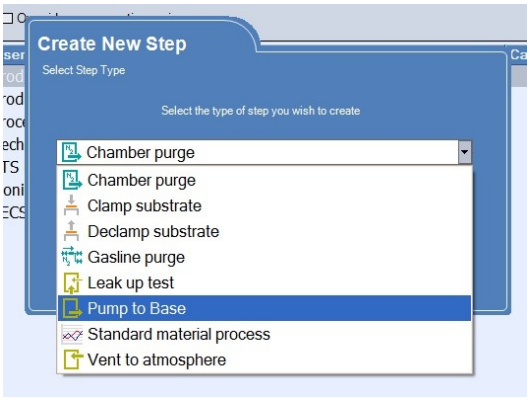
The recipe will appear at the bottom of the list (it will be sorted alphabetically next time the software is restarted):



To copy and existing recipe, click on the ***Import*** button and select the recipe from the list (it may be necessary to opening the file to be copied first and ***Export*** it).

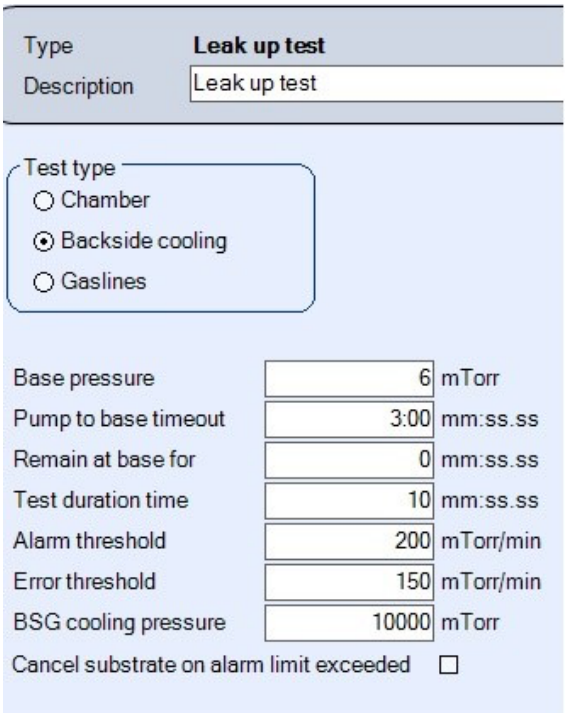
To create an original recipe, follow these steps:

Click on the ***New*** button to add the required steps:



Add the following steps in order:

Pump to base
Clamp substrate
Leak up test
Standard Material Process
Pump to base
Declamp substrate



Click ***Apply*** to save changes, then click on the ***Standard Material Process*** step to edit the process parameters.