

# First Year Impact Report of the CFPGP on the ASRC Nanofabrication Facility

February 15, 2024

*Question: Please let us know whether the additional personnel allowed your core to fill the needs you identified in your grant application*

Salam Elhalabi, our cleanroom technician, began work in the nanofabrication facility in February of 2022, and has been with us for 1 year now. It is amazing that she has fulfilled literally all of the objectives for the tools that we originally trained her on and assigned her, and now we are working to expand the scope of her tool expertise to more tools as she continues to gain experience. The goals set out in the original proposal have been, and continue to be realized.

The primary issues we needed to address was to develop robust tool preventative maintenance (as opposed to maintenance when a tool fails) for key tools, and also to help create processes and documentation that would enable reproducible usage of the tools. This included developing process recipes for users, and tool measuring tool performance standards. However, we did not have the staffing to take these preventative measures previously.

To quickly summarize the proposal, we planned for Salam to do the following:

1. Develop routine preventative maintenance
2. Characterize baseline processes
3. Work with users to train and develop their individual processes

## Managing three AJA metal and oxide deposition tools

Currently Salam is tool manager of three tools in the nanofab, namely, the AJA metal evaporator, the AJA organic evaporator and the AJA sputter tool. These tools required a great deal of maintenance, and the performance was not optimized. In fact we needed to take these tools offline and rebuild each of them during the initial phases of her employment.

The following are specific goals attained with the addition of Salam and the time she was able to dedicate to these tools:

1. Training on the tools is now expanded to a 1.5 hour session, followed by a 1.5 hour one-on-one tool qualification. This has resulted in the tool almost never going down due to user misuse, as the users are only allowed to use the tool when they understand all aspects of operation. Old users of the tool have been restrained to satisfy the new requirements.
2. The organic evaporator, which was originally only used for thermal evaporation of organic molecules (as its name implies) is now used for metals and other oxide

materials in conjunction with the metal evaporator, and between the two we have 12 materials available to users at any instant in time.

3. Salam has developed process charts that now sit at the tool, where each user has available previous tool history, the power range that the deposition should take place at, the effect of pressures, and rates of deposition that they can expect.
4. The tools are monitored daily, and things like cryo temperatures and base pressures are monitored to tell the life of the cryo pumps. When temperatures start rising, we are able to regenerate the pumps before there are unexpected failures. Salam is able to independently regenerate the pumps herself, a complex day-long multistep process.
5. The crystal monitors are also monitored, and replaced before failure, so that the tool does not go down when users are using the tool. (Scheduled downtime is far better than unscheduled downtime that interferes with a user's process).
6. We have learned together with Salam and working with the tool manufacturer, different aspects of the tool operation that have never been optimized before, including the beam sweep and beam position, allowing now for consistent and reproducible depositions, which were not the case before.

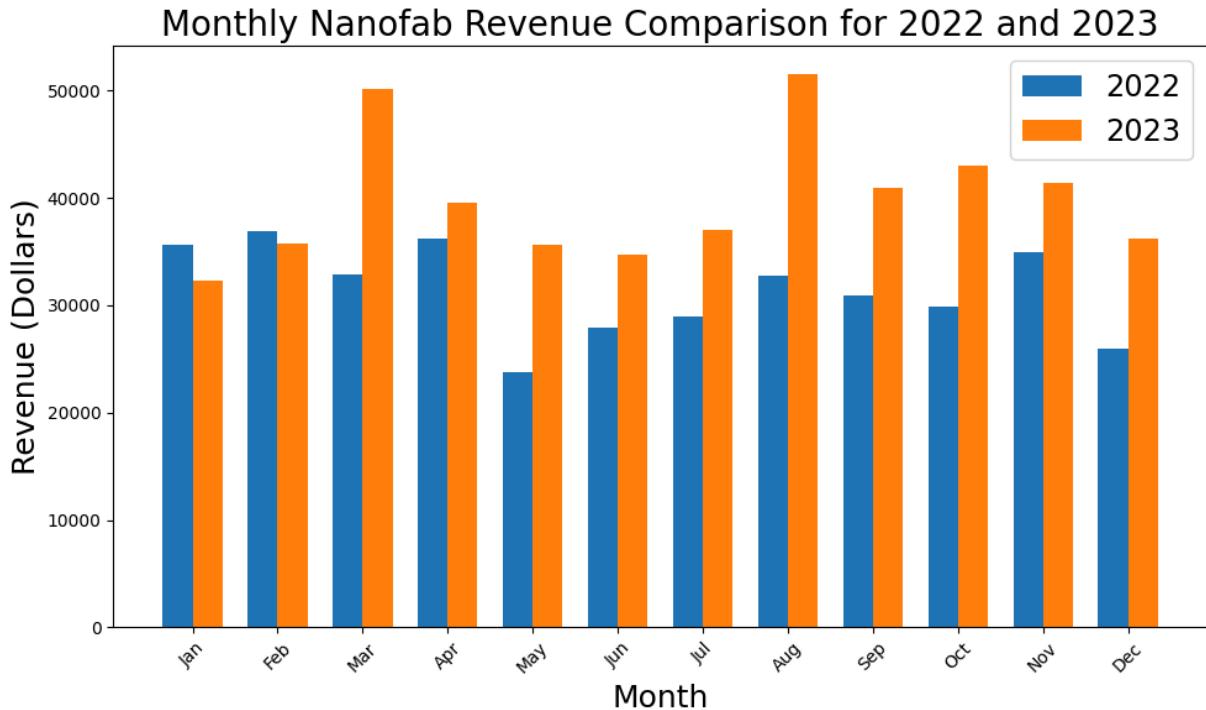
## Support of other Facility tools

In addition to these enhancements of the three tools that Salam directly manages, Salam has helped with and can back up the training and management of the three RIE and ICP etchers. She is able to help restore the computers and reset the two Elionix E-beam lithography tools, and she is a constant presence in the cleanroom, has gotten to know the individual users and know their habits, and this has greatly enhanced the users ability to easily interact with staff. Additionally, Salam is able to be a backup to other staff members functions, which is essential for us to provide redundancy in the training and when other staff members are out on vacation or sick.

The future goals we have established during Salams recent review (review also attached to this email) are to expand her knowledge to other deposition tools, specifically the Atomic Layer Deposition (ALD) tool, and the Plasma Enhanced Chemical Vapor Deposition (PECVD) tool. We are also looking to train her in further characterization of the films that are deposited, using AFM and SEM, as well as to be able to back up Shawn in the basic repair of some tools in the facility.

## Nanofab revenue to support this technician position

The nanofab has also taken measures as promised to generate the revenue required to pay Salam beyond the length of the ASRC grant timeline, scheduled to end in 2 years. A month by month comparison of the revenue generated in the nanofabrication facility can be seen in the graph below (Figure 1). We see an increase in revenue since March of 2023 over the previous year for all months. This has been accomplished by introducing a modest lab entry fee, training fees, and adjustments to the external academic caps.



## Summary of Success

With the addition of Salam, we now have a filled out staff, which is capable of maintaining and further improving the tool stability and enhancing the ASRC Nanofab users experience. The ultimate goal of the facility is to facilitate cutting edge research, and Salam is critical to allowing all staff to do their part to accomplish this. Thank you for initiating and continuing support of this position.