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Labview Applications for Quantum Mass Spectroscopy

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Labview Applications of QMS

Introduction

Over this semester, I have conducted an independent study in the Laboratory for Emerging and Applied Nanomaterials. My goals for this independent study was to automate the atomic deposition layer (ALD) system and couple the quadruple mass spectrometer (QMS) to the atomic layer deposition graphic user interface to bring in the data acquisition from the QMS and ALD under an integrated user platform.

My objectives to achieve this goal was to be proficient in Labview Instrumentation and Automation software and to use the software to acquire ALD process data and develop more information about the ALD process. Another one of my goals was to gain knowledge in the field of nanoscale science by learning the mechanism behind the equipment typically used in a research lab.

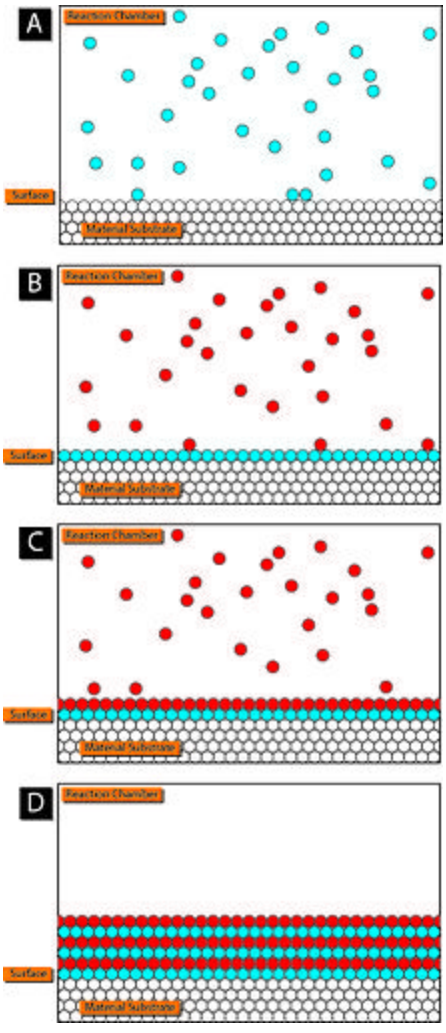
My criteria for measuring the the extent my goals were achieved was to demonstrate control of the labview modules to control the QMS, to be able to successfully integrate the modules into the ALD process control, and to demonstrate knowledge of Labview and of the QMS through this process.

I believe I have met these objectives in the way the criteria describes. Over the course of this paper I will describe the background information I learned in order to achieve these objectives, as well as the labview programs I wrote over the course of the independent study, and explain how each of these contributed to achieving my overarching goals.

Background Information

Over this section I will describe my knowledge of quantum mass spectroscopy, vacuum technology, and atomic layer deposition.

For gaining knowledge of quantum mass spectroscopy, I read the manual that came with the instrument to gain knowledge of the different parts of the instrument and how they worked together to produce readings. I also read the section on how to program it so I could make changes to the computer program that controlled it. Through doing these readings I gained a better understanding of the structure of the instrument.



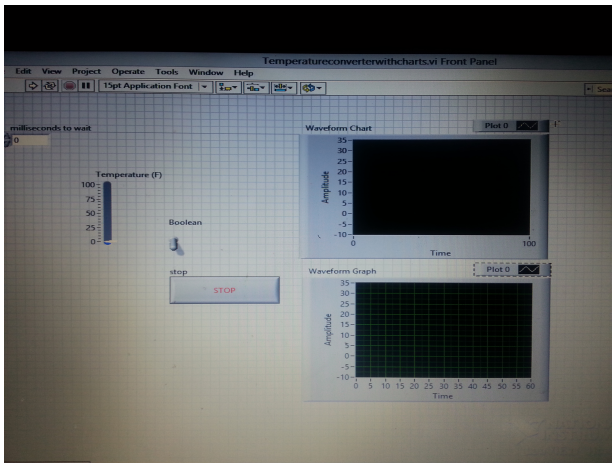
To gain knowledge of vacuum technology, I read A User's Guide to Vacuum Technology by John O'Hallon. This was helpful because I was able to apply the things I read to my knowledge of quantum mass spectroscopy, because QMS uses vacuums in its instrumentation, specifically, the vacuum pump, of which the purpose is to pump in gas into the system.

Next, I will talk about my knowledge of atomic layer deposition. I read several papers on ALD. ALD or atomic layer deposition is a thin film deposition method. In this method, a film is grown on a substrate by pumping different gases into a chamber. Only one gas is allowed in the chamber at a time; alternating these gases causes layers of different species to form.The molecules react with the molecules

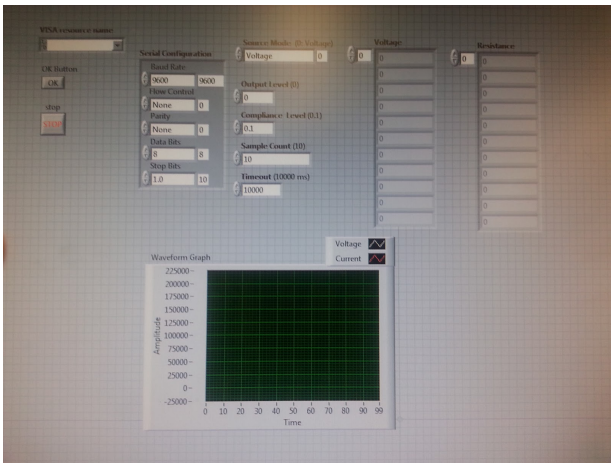
formed by the previous surface so that the reaction terminates once all the reactive sites on the surface are consumed (self limiting). By using this method, one is able to control the height of very think film (nanometer scale) to a precise degree. The image shown to the left (figure A) demonstrates this process, and shows how two different gases (blue and red particles) alternate with each other to form a film with many layers.

Labview Implimentation

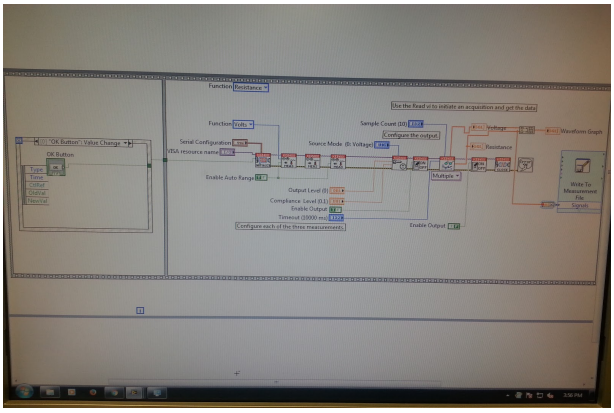
Next, I will talk about my knowledge of Labview. I taught myself how to program in Labview in order to be able to implement the program by controlling the instrument. I did this by watching various video tutorials. Below is a picture of one of my final codes. The purpose of this code is to measure convert farenheit to celcius. To achieve this, I used a while loop to continuously change the temperature based on an initial slider. I also added an option to move the slider, but keep the temperature the same (so basically, Fahrenheit to Celsius or Fahrenheit to Fahrenheit). The program then plots the results on two types of graphs (real time, and total time changes). I chose to design this program because I believe converting temperature could have use as a subVI in another program. The front panel is pictured to the right (figure B).



Next, I will talk about my knowledge of instrument control by using Labview gpib programming.



The purpose of this goal was to get multiple readings off the Keithley 2400, then save them in a file, as well as plot them on a graph. To achieve this, I used previously coded sub VI's as well as ones I coded myself. I did this by activating the VI's that controlled the instrument, then got readings off them. I used a substructure to enable the user to start the program when they wanted to with a start button, and also had a save file and a while loop to enable the program to run continuously until it got the required number of readings. The results were then graphed using a waveform plot. The front view and the block diagram of the program is shown to the left (Figure C and D).



Conclusion

In the previous sections, I have described what different processes I have accomplished during my research. Now, I will evaluate what I worked on based on the criteria that I gave myself at the beginning of the year. A problem with using this criteria, however, is that the instrument I was to work on, the mass spectrometer, was not functional during most of the semester. I will therefore evaluate my success by adjusting my criteria to account for this unforeseen problem.

As mentioned previously, my criteria for measuring the objectives was to demonstrate control of the Labview modules to control the QMS, successfully integrate the modules into the ALD process control, and demonstrate knowledge of Labview and of the QMS in order to do this. Most of these criteria depend on QMS programming. However, I believe I have demonstrated a sufficient knowledge of this criteria in every way that does not involve the QMS. I have demonstrated knowledge of instrument control by programming the Kinsley 2400, a process that could easily be transferred over to the QMS. I have also demonstrated knowledge of atomic layer deposition and QMS in a non-programing way by the background research I performed on those topics. I also believe I have demonstrated thorough knowledge on Labview, as most of my work depended on using it in various instrument control.

In conclusion, I believe I have achieve all my overarching goals through fulfilling all the non QMS aspects of my project. Through this independent study, I have gained proficiency in instrument control through the use of Labview, as well as gain knowledge of how a variety of laboratory instruments work.