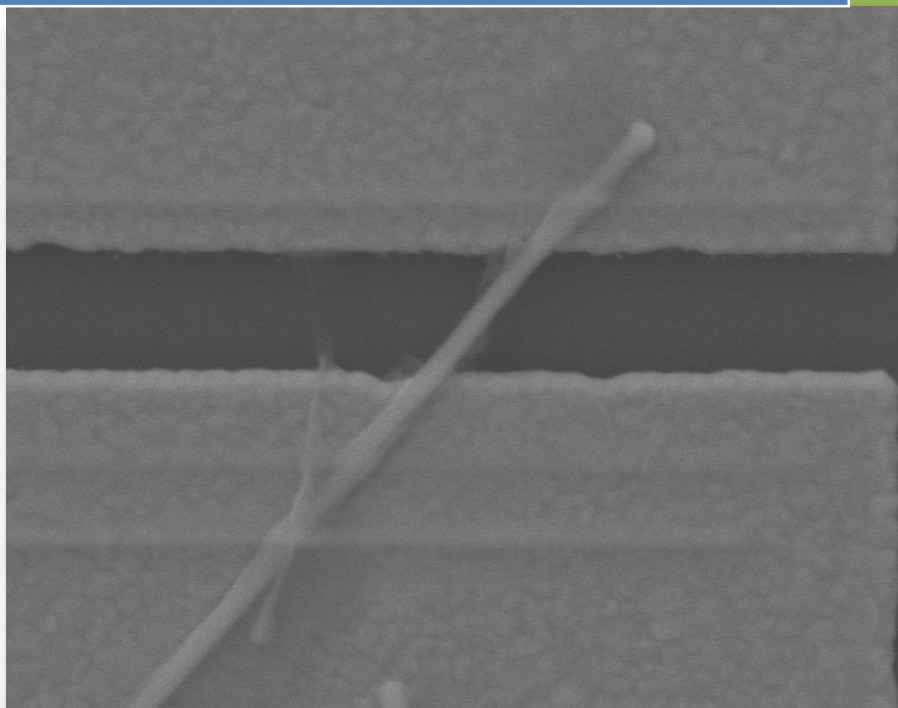


RAPME Summer Engineering Institute

2015

Final RAPME Paper



Mag = 35.66 K X 300 nm WD = 6.3 mm EHT = 5.00 kV Signal A = SE2 ESB Grid = 0 V Date :16 Jul 2015 Time :11:4
Auriga-45-56 FIB Imaging = SEM FIB Lock Mags = No FIB Probe = 30kV:50pA System Vacuum = 4.82e-006 Torr

Jerome Pratt II

7/23/2015

The 2015 RAPME Summer Engineering Institute was an amazing and extensively challenging program made for educated minorities that are academically responsible enough to complete the summer laboratory program requirements at Virginia Commonwealth University, School of Engineering. During this summer session of RAPME three students including myself have visually and orally received information about the engineering of nanotechnology. This program has given me the eligibility and access to visit and receive training in some of VCU's top laboratory's and allowed me to be instructed on SEM machinery. As a result of this training, I have become one of few high school kids to pass and become certified on the clean room procedures. It has given me a technical drive and outlet to explore the world of nanotechnology.

My partner Michiah and I started the RAPME program off with our teacher Mr. Mamun. During our first session with Manun we learned about some of the basics of what we were going to be doing throughout our RAPME experience. We were learning in a class room setting how to grow nanomaterials on a substrate. Next we learned about magnetics and poles and also recapped many things we learned in elementary and middle school such as the north and south poles of a magnet. Although we learned about magnetics we also talked about two other main topics that interact with nanotechnology and engineering and those two subjects are chemistry and also physics.

During the program we worked with John Dalton's Theory that all matter is made of atoms and that atoms are invisible and indestructible. All atoms of a given element are identical in mass and properties. Compounds are formed by a combination of two or more different kinds of atoms. Lastly, a chemical reaction is the rearrangement of atoms. We also worked with electron clouds and learned about scatter electron that can be reused inside of an SEM (Scatter Electron Microscope).

After working with and relearning some fundamental rules of chemistry we soon determined that we would be working on and with electrons and nanomaterials throughout the entire program. Around the third day of the program Mamun took us to a space called the clean room where he went inside and we viewed through the viewing window outside. Once I looked through the clean room window I was fascinated by all of the extravagant, mind boggling machines and testing equipment. Soon after I looked through that viewing window I saw Mamun walking by in what seemed to look like scrubs directing us through the glass about what he was about to do. He was about to build what he has relentlessly been telling us about. He was electro polishing the aluminum substrate right before my eyes. By electro polishing the aluminum substrate it becomes ultra-smooth making the nanostructure grow faster and much easier allowing for shorter wait times and better results. This ultimately makes the process more efficient.

After the electro polishing the metal became highly reflective and formed in a circular region on the aluminum substrate. Once the entire electro polishing process has been completed the next necessary step is the process of Anodization. By using the aluminum substrate as an anode and a platinum mesh as a cathode you will eventually fill up the cell with a suitable acid and then apply a DC voltage between the anode and the cathode.

The next day we came back to an already grown nanostructure. After the structure was grown we ventured to look at our nanostructure under the Scanning Electron Microscope. On the very last day working with Mamun we were told to come back that very same day to take our very important safety test.

To start off, during the safety lesson we all sat down and were given a lecture on learning the importance of proper conduct inside of the safety lab and to know what to do in emergency situations. For example, if we were to come into contact with harmful chemicals, what actions would you take and also, what to do in case of fire and or other types of emergency. We had to complete and pass this test to be able to continue in our journey in the summer program. To pass the extensive test, we had to get every single question right. Once I passed the test I became one of few high school students permitted inside of the cleanroom to explore and venture with my instructor and watch up close everything that he or she was doing. So passing the safety laboratory test was essential to completing the

Summer Engineering Institute RAPME program at Virginia Commonwealth University School of Engineering.

After that was all said and done it was time to transition in to the next week with Iftekhar. During my time spent with Iftekhar I learned more about the physics side of nanotechnology. I learned about structures that are one dimensional all the way up to four dimensional objects. I learned that it all correlates with the main focus of engineering and nanotechnology.

Working with Iftekhar was probably my favorite time during the summer program. He showed us more in depth what was happening and also told us more about how they grow and how you make them grow from scratch. Iftekhar also explained to us about Electrodeposition. Electrodeposition is the filling of the pores with a heated solution composed of a salt and then apply an AC voltage to the cell which causes the nanostructure wires to grow. Even though it doesn't seem so hard it was a long and strenuous process requiring hours of wait time. During one session with Iftekhar while waiting my partner and I dressed out in laboratory clothes three separate times! During some of the waiting time Iftekhar, Michiah, and I actually had time to talk and learn some interesting things about each other. I learned that Iftekhar is an academically gifted person passing every excruciatingly hard test he takes. I also learned some things about Michiah as well. I learned that

she has a little sister also in the RAPME program. I also learned that Michiah wants to eventually become a doctor someday.

After a while it was time for the final step of the process and that was characterization. To characterize our structure we had to use the Scanning Electron Microscope. This piece of machinery shows the formation of the nanowires within the pores. The SEM uses an electron beam to see a visual of the structure, but the SEM also has a small probe with an extremely small tip that probes the sample by scanning it using a light tapping motion or by using magnetic repulsion from the sample.

The next week session Michiah and I worked with Harini, Naveen, and Majabin. While working that week I was able to go in to the clean room with Harini and Majabin.

There we started on yet another structure starting and completing the polishing again and then started to build another Nanostructure. While in the clean room we all talked and enjoyed our self while waiting on our structure to grow. The next day we came back together again to take a real tour touring the SEM laboratory with the director of the lab covering all of the safety protocols so we knew what to do and what not to do in case of emergency. Once that was

completed we received the amazing opportunity to become trained on one of the SEM machines.

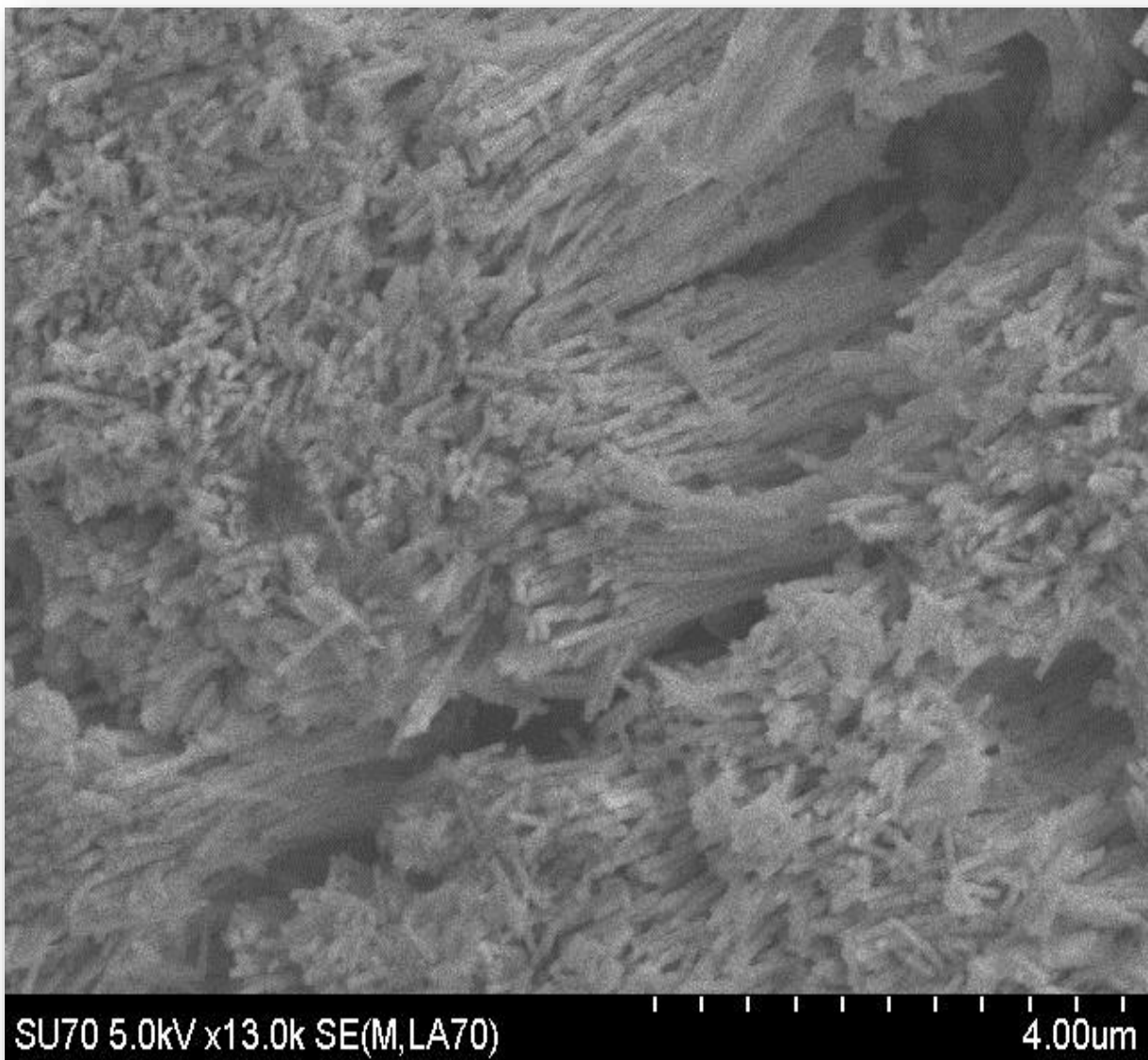
We came back the next day and were immediately greeted by Dr. Carlos E. Castano, PhD. He is the Nanomaterials Core Characterization facility associate of the Chemical and Life Science Engineering Department. Through his instruction we were able to be taught the right and wrong ways how to use the SEM. We were told about the importance of the vacuum seal, the electron beam, and also how to properly use the picture focus.

Once we were told all of the crucial things about the SEM and how to use it he eventually let us team up and try to solve a murder mystery between a spider and two flies. Working together we had to figure out which fly did the spider kill. We searched and searched and found some really cool stomach churning things like hundreds of fly eyes and severed limbs of a spider. Soon after a couple of hints from Dr. Carlos we were able to find an extremely thin blanket of web surrounding the metallic fly corpse concluding our search. Finally on the last day Naveen was able to work with us and show us all of the SEM's in that lab giving us an extensive overview on everything that we learned, worked on and completed during our Summer Engineering Institute. At the conclusion of the overview, Naveen gave us one more lesson on the SEM and then we said our final goodbyes. It was truly an awesome experience.

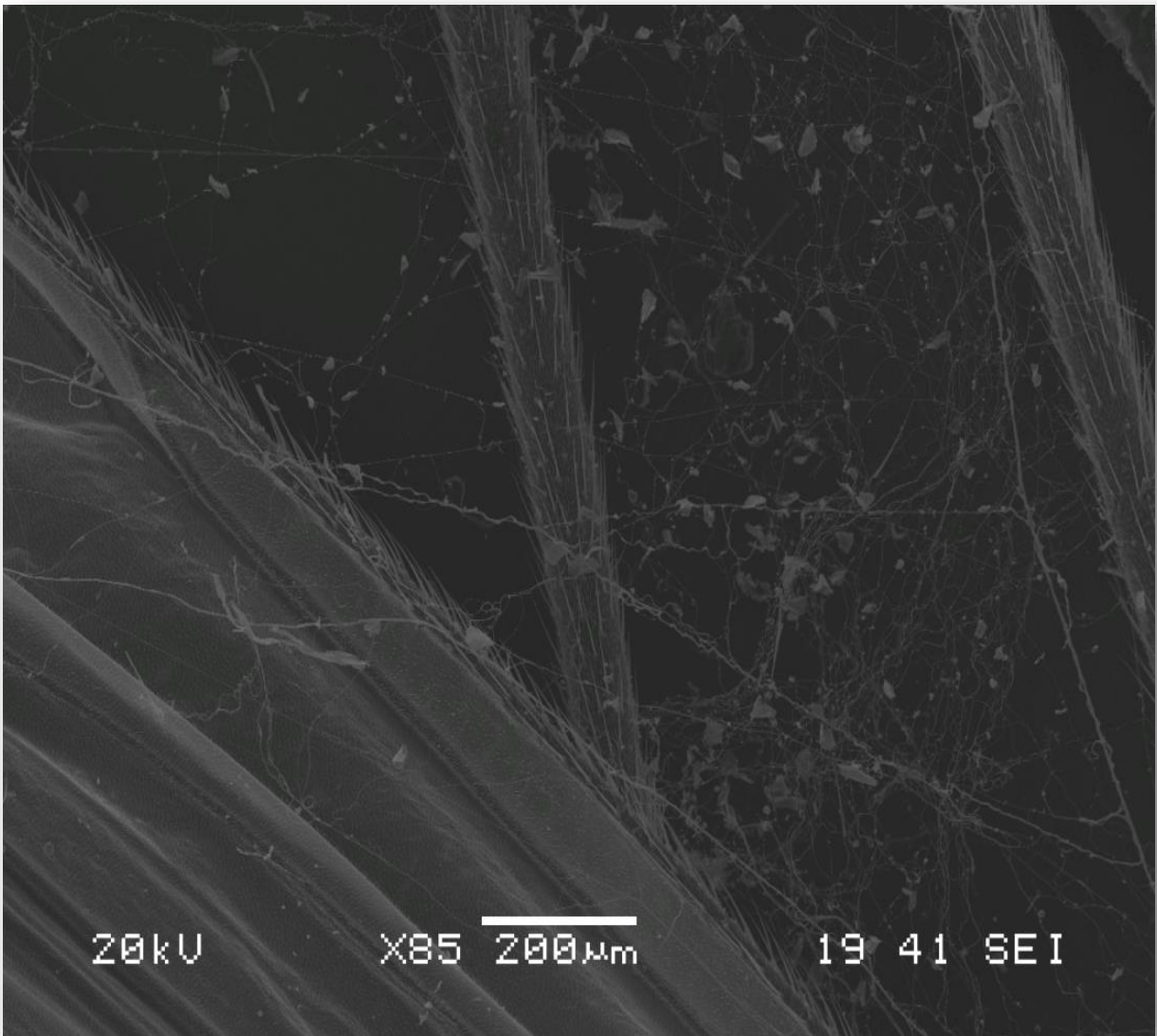
RAPME once again is an amazing and extensive program that is distinctively made for educated minorities that are academically responsible enough to complete the program. During this summer session of RAPME three students including myself have visually and orally received information about the engineering of nanotechnology. This program has given me the eligibility and access to visit and receive training in some of VCU's top laboratory's and allowed me to be instructed on SEM machinery, and become one of few high school kids to pass and become certified on the clean room procedures. It also afforded me the opportunity to explore the world of nanotechnology making this the very best RAPME experience I have ever had.

The following laboratory pictures were taken during my summer 2015
RAPME Summer Engineering Institute at Virginia Commonwealth University,
Richmond, Virginia.

(Figure 1)



(Figure 2)



Fly mystery solved

Source Page:

- PDF file Nanowire Fabrication Process
by: Saumil Bandyopadhyay