

NDnano Undergraduate Research Fellowship (NURF) 2015 Project Summary

1. Student name: Austin Cullison
2. Faculty mentor name: Gary Bernstein
3. Project title: Repair of and Research with a Scanning Electron Microscope
4. Briefly describe any new skills you acquired during your summer research:
I am now able to operate and do maintenance on a scanning electron microscope (SEM).
5. Briefly share a practical application/end use of your research:
I was able to get the SEM working at much higher magnifications. As well as researching the possibility of harmful nanoparticles in fire extinguisher powder.

Begin two-paragraph project summary here (~ one type-written page) to describe problem and project goal and your activities / results:

The Elionix ERA-8900FE scanning electron microscope (SEM) was having several problems which effected resolution and operation of the SEM. Of the SEMs problems vibrations picked up through the floor and a power/ground issue were the most significant. Once these problems were solved the goal was to research the possibility of harmful nanoparticles in fire extinguisher powder.

To solve the vibration problem a self-leveling air spring system was used. The air spring system was extremely effective in reducing the vibrations. In fact, the vibrations were reduced by more than an order of magnitude. The reduction in vibration can be seen by comparing Figures 1 and 2.

During the install of the air spring system a power outage caused a problem due to an expired backup battery. Once the battery was replaced and power was restored the SEM was rebooted. During reboot the programmable logic controller was stuck on one step, which was not allowing the SEM to fully reboot. While troubleshooting the PLC a bad ground on one of the inputs was found. Once this input was repaired, the reboot process could be completed.

With the SEM running correctly, research could then be completed using it. Many different samples of the same ABC fire extinguisher powder were viewed trying to find nanoparticles, which could be toxic, or asbestos-like particles. To get the best resolution a sample had to be sputtered with gold to

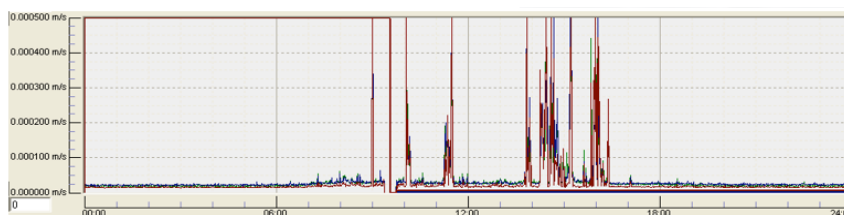


Figure 1: Before install scale max 0.0005m/s

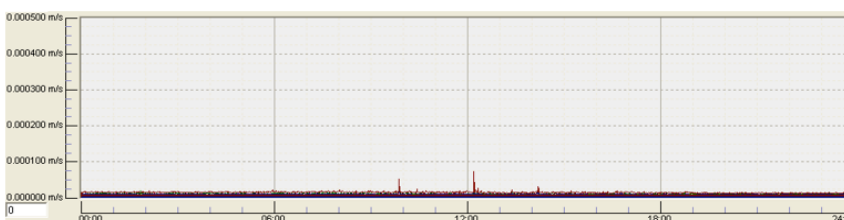
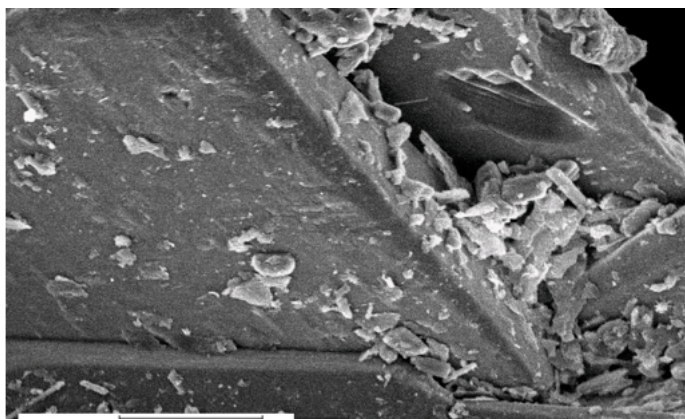


Figure 2: After install scale max 0.0005m/s



keep the powder from charging. Once sputtered, the smaller particles could be seen with a much higher resolution (Figure 3). The smallest particles that could be found were the size of a micron and no asbestos-like particles were found.

With no nanoparticles or asbestos-like particles found it is easy to conclude that the sampled powder is not harmful in those ways. The upgrades and repairs made to the SEM will allow others to view/image samples at a nanoscale.

Publications (papers/posters/presentations): Poster presented at Summer Undergraduate Research Symposium, July 31, 2015.