MICROSCOPES & MUSIC

HARMONIZING TO CREATE EDUCATIONAL OPPORTUNITIES

HILTON HEAD ISLAND, SC – March, 2021 - - AFMWorkshop is developing an educational program to introduce high school and undergraduate students to the wonders of nanotechnology: collaborating with, of all people, music director and conductor Kimberly Grigsby.

Yes! A musician!

A successful conductor and music director for more than 20 years, Kimberly was poised to preview the new Broadway musical *Flying Over Sunset* in March 2020. The curtains were set to rise, and inside her dressing room the champagne was ready to pour. Future engagements were booked in London to set the West End production of *To Kill A Mockingbird*; and in Sydney to conduct *The Light in the Piazza*, starring Renee Fleming.

Alas, as COVID-19 took a horrific toll on lives and livelihoods in New York, theaters were closed. Broadway was silenced.

Conductor & Music Director Kimberly Grigsby. Photo by Bill Wadman

For a musician and performer like Kimberly, silence was torture. So she embarked on a COVID-safe road trip around the country, including a stop in Hilton Head Island, S.C. – home of her friend Pamela Stone, and AFMWorkshop.

Kimberly and Pamela had met one dozen years ago while surveying anti-hunger and poverty alleviation community programs in Cambodia and Vietnam with Heifer International: a leading NGO. But this latest alliance would prove exploration of

another kind, as a new joint project was born!

About AFMWorkshop

Pamela and her husband Dr. Paul West own AFMWorkshop, a leading manufacturer of Atomic Force Microscopes (AFM): high-powered microscopes capable of magnifications of up to 100-million times. While Paul is a scientist, inventor and entrepreneur involved with AFMs since their initial development in 1981, when engaged in postdoctoral work at California Institute of Technology; Pamela's background is at a more macro level – addressing environmental and humanitarian issues through work at various humanitarian and charitable organizations.

Now working together with her husband at AFMWorkshop, Pamela has been developing a new program to expose high school and undergraduate students, along with educators, to educational AFMs.

Finding Nano

But a few key elements were missing from the promising educational plan. Pamela and Paul had even wondered if it was realistic to attempt a shortcut technique that would enable an inexperienced student to operate such a cutting-edge, advanced piece of equipment. They were also unsure of the types of samples that would interest younger students, while still demonstrating the functionality of an AFM for educators.

Once Kimberly reunited with Pamela and Paul on Hilton Head Island, she eagerly joined in on the discussion. But Kimberly had an ace up her sleeve. Her music career had previously included a variety of roles in education: she had classroom experience to share and an interest as well. Kimberly agreed to learn to operate the AFM and begin exploring how to utilize her teaching and interpretation skills to tailor the curriculum to students.

The partnership was not as far-fetched as it might have seemed. Kimberly's father, Stanley Grigsby, is an applied physicist by profession, and she had easily mastered high school science courses. Fate and passion had pulled her in the direction of the arts and a career in musical theater: but her collaboration with AFMWorkshop would return Kimberly to her roots.

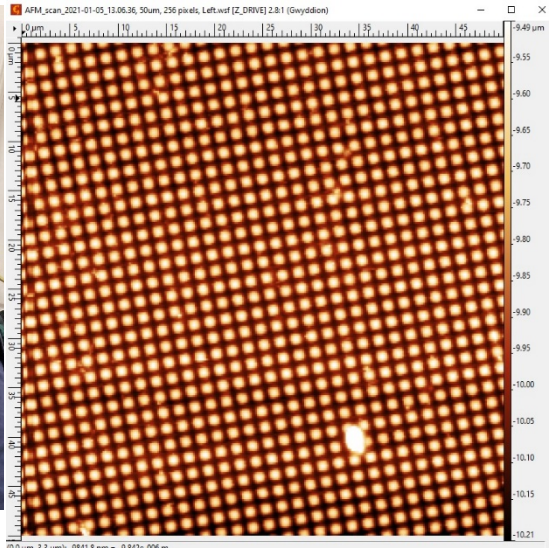
She began by studying the details of how the microscope works, and after a brief tutorial on the microscope operation and control software, she was ready to roll.

One of Pamela's primary objectives had been to view samples with the AFM that students would find interesting. What are modern-day students heavily engaged with? Cell phones! The cell phone would be a prime candidate as Kimberly's first sample, resulting in her first AFM image. Every smart phone has one

or two CMOS (Complementary Metal Oxide Semiconductors) used in taking photos and videos. These cameras are made with highly complex fabrication techniques and have features only a few thousand nanometers in dimension: the entire image would easily fit on the cross-section of a human hair!

From CMOS, Kimberly moved on to image many more specimens with the AFM. She continued to focus on samples of potential interest to students, yet relevant to nanotechnology: a broad range from crab shells to paper filters, DVDs, catalytic converters and semiconductor device structures. By the end of the three-week trial Kimberly had developed proficiency in AFM operation and demonstrated that these powerful microscopes can be mastered from a cold start by an untrained individual.

Kimberly Grigsby with the BAFM



Kimberly's first AFM Image - a cell phone camera. The entire field of view of this image is 2/3 the diameter of a hair.

From Zero to Nano in Three Weeks

"Kimberly started with absolutely zero knowledge of AFM and that was a vital perspective we needed to learn from," said Pamela. "She was key to growing our understanding of what would – or would not – make sense to students who are going to be our primary AFM users. Her perseverance, willingness to be a 'guinea pig' and ability to provide thorough documentation of her journey enabled us to confidently move forward with the knowledge that this leading-edge technology can be absorbed and manipulated by our future innovators!"

Kimberly noted the commonalities between her expertise in music and conducting, and her experience with the AFM. A big fan of moving STEM learning (Science, Technology, Engineering and Mathematics) into an integrated learning approach of STEAM (Science, Technology, Engineering, the Arts and

Mathematics) she said, “For me, science is creative. You have a goal, you follow a process, and there’s a technology that allows you to achieve these AFM images. But once you have the image, it forces the question: ‘How do you make this image appealing?’ The information is all there; the properties remain the same; the measurements have been made: that is the science of it. But every person will make that image look aesthetically different, combining science and creativity.”

And both science and music, she said, “involve discipline. You follow a specific procedure to acquire an AFM image. Likewise in music, you have to ensure the tempo is right; whether you play the notes legato or staccato; and follow the phrasing and dynamics. In both cases, you take all the parameters, then apply your individual interpretation and approach to it. That is what makes it unique. You bring your images – or music – to life.”

Another critical aspect, Kimberly pointed out, is developing an aptitude for troubleshooting: “Studying and learning enough of the facts and science to allow you to troubleshoot when things go awry. This encourages creative thinking, to understand what went wrong, and encourages resourcefulness to solve problems.” She chuckled, “One of the funny dichotomies is that with microscopy, you take the whole and break it down into parts. Whereas in music, it is the combination of parts that make the whole!”
But how does this all apply to young students?

“The whole concept is fascinating. We look at the stars, the universe, or we hike up a 12,000-foot mountain and realize, ‘Wow, I am really small!’ Conversely, with an AFM we can see things just one nanometer or 100 nanometers in size, and this helps so much with perspective,” Kimberly continued. “’For students to have this exposure – from the expanse of outer space, all the way down to the atomic level – and see how these things are similarly structured with building blocks. And once a student understands that concept, the door is open to create more, or use the similarities in structures to support synergy. It also gives us a deep appreciation for things, once you understand what they are composed of. While I was using the AFM I looked at both man-made and natural objects, and it was fascinating to see how these structures vary.”

AFM technology is a newborn baby in the world of microscopy, Pamela pointed out. “So many senior scientists are accustomed to doing things a certain way, they don’t have the time or mental flexibility to visualize the possibilities an AFM can help shape. But young people are fresh and ready to absorb and create! Their exposure to AFM at an early age can spark a passion for using this tool to create a different future.”

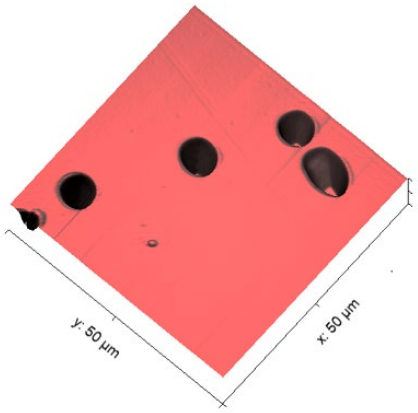
“If I started talking about some of the possibilities pursuing nanotechnology could yield, you might really think I was hallucinating,” Pamela continued. “But, starting with a concrete tool like exposure to this new AFM, our young people can work to make the surreal, real.”

Kimberly concurred. “It is so beneficial when you’re young to have these kinds of exposures, in order to discover what interests you and to find your passion. Otherwise, how would you know? And even if you’re not interested in the image, the way it arrived is fascinating. Perhaps exposure to this will pique an interest in lasers? Photodetectors? Or even physics, to understand: ‘How is this laser making this probe go down?’ With frequency, with vibration. It’s all very cool!”

AFMWorkshop Education Program

At present the AFMWorkshop education program is in the final stages of development, according to Pamela, and the group is establishing various curriculum modules. As a bonus, Kimberly’s shared enthusiasm for the AFM sparked her father’s interest in partnering with AFMWorkshop. Previously an Assistant Professor of Physics, Engineering and Statistics at Ottawa University, Ottawa, Kansas, he had been contemplating what would come next in his personal journey. “Based on conversations with Kimberly he is ready to collaborate with our educators to help enhance our scholastic programming,” Pamela announced. “We are excited about this endeavor and the chance to introduce more practical and exciting STEAM opportunities to students.”

For more information on AFMWorkshop and/or the AFMWorkshop Education Program, please visit www.AFMWorkshop.com or contact Pamela@AFMWorkshop.com .



Kimberly's three dimensional image of the pores in a plastic filter.