SPRING 2021

CIRCUITS

A MISSISSIPPI-LED REVOLUTION IN MEDICAL IMAGING, PAGE 8

Mississippi EPSCoR

WHAT IS EPSCoR?

The Established Program to Stimulate Competitive Research is a science and technology (S&T) research and development program that seeks to enhance research competitiveness for eligible jurisdictions. The program's goals are focused on strengthening STEM capacity through increased research capabilities, pathways for the development of STEM professionals, broadened participation of diverse groups and institutions in STEM, and jurisdictional economic development. All of this is achieved through the support of talented researchers at universities across our state.

CENTER FOR EMERGENT MOLECULAR OPTOELECTRONICS

The Center for Emergent Molecular Optoelectronics (CEMOs) is the latest research infrastructure improvement award from the NSF to the state of Mississippi. This five year, $20M award will support the project's mission to establish a sustainable statewide interdisciplinary research infrastructure that will enable Mississippi to address fundamental challenges associated with advanced materials, increase the state's competitiveness in optoelectronics research, and drive cross-fertilization of research, education, training, and entrepreneurship to build the STEM workforce.

The project is composed of investigators from each of the state's research institutions who will work to address critical and contemporary optoelectronics challenges in key focus areas of fundamental science and engineering research and education. The work being conducted through this award is vital for the advancement of diverse technologies, such as sustainable energy, electronics, and biomedicine, critical to enhancing the competitiveness of existing industries and attracting new companies in the Mississippi Science and Technology core priority areas of energy, advanced manufacturing, and health. Workforce development efforts are integrated with the research and aimed at attracting, developing, and retaining top research talent and engaging a diverse body of K-14 students in STEM. Research-based education and outreach activities for K-14 students and teachers will help build the pipeline of next-generation STEM students.

Overall, the Center will facilitate the development of research capabilities, infrastructure, and educational opportunities in important fields of optoelectronic, energy, and biotechnology research. These capabilities are critical to sustain and advance nationally competitive research programs, support basic and applied research, increase public awareness of STEM career opportunities, and establish and maintain a solid scientific infrastructure in our university system with the potential to translate into new technologies with the potential for job creation.

Cover photo: Graduate student Ravinder Kaur with Dr. Jared Delcamp

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This material is based on work supported by the National Science Foundation under Grant No. 1757220.

LETTER FROM THE DIRECTOR

Dr. Julie Jordan, Program Director

Mississippi State University

Vice President for Research and Economic Development

Dr. Jordan earned her bachelor's and master's degrees from MSU in industrial engineering and education technology, respectively, in addition to a doctorate in international development from the University of Southern Mississippi. She has over 30 years of experience as an educator, entrepreneur and administrator in various public and private sector positions. Throughout her career, she has worked to build positive relationships among people and organizations to produce positive outcomes and identify and develop talent to empower individuals to meet organizational and personal goals.

Despite facing such a challenging year in 2020, we look back on the progress we've made in classroom and workplace technology integration, creative problem solving, and research innovation. Through these trying times, our Center for Molecular Optoelectronics program has continued to exceed expectations by consistently surpassing yearly targets and progressing research developments into the next stages of the five-year project. While it has been challenging without face-to-face communication, everyone has had a part in making the continuation of the research and outreach events look like smooth-sailing. Even our reverse site visit with the National Science Foundation was a success in possibly the most uncertain of times. I want to thank everyone who has a hand in the project for working so diligently to keep us moving forward throughout the pandemic.

In this newsletter, the EPSCoR CEMOs team wanted to highlight some of the project aspects through the faculty, students, and even a member of our Science Advisory Board. We hope that you will find their different points of view on the project exciting and learn more about how EPSCoR increases research efforts and interest throughout the state of Mississippi. Please help us promote our project by sharing this newsletter with your friends, colleagues, and elected officials in your community.

Sincerely,

Julie Jordan, Ph.D.

NSF EPSCoR Impact to Mississippi Since 2006

391
GRADUATE STUDENTS

61
NEW FACULTY HIRED

$65,948,444
NSF EPSCoR FUNDING TO MISSISSIPPI

$232,745,726
GRANTS AWARDED TO MS EPSCoR FACULTY

67,829
PEOPLE
EXTERNAL STEM ENGAGEMENT

53,996
K12 STUDENT ENGAGEMENT

364
UNDERGRADUATE STUDENTS

2,642
OUTREACH TO K12 TEACHERS

1,403
TOTAL PUBLICATIONS

NEW SEED GRANTS AWARDED TO FURTHER EFFORTS ON NSF RII TRACK I PROJECT

On December 7th, 2020, the Mississippi EPSCoR NSF RII Track 1: Center for Emergent Molecular Optoelectronics (CEMOs) awarded funding to three assistant professors as part of a seed funding program designed to foster new, innovative, and transformative research collaborations. Proposals submitted to the funding opportunity were targeted at the four research focus areas within the center: Infrared Organic Optoelectronic Materials & Technologies, Multifunctional Macromolecular Materials with Tunable Electronic Structures, Emergent Materials for Hybrid Organic/Inorganic Interfaces, and NIR-SWIR Emissive Materials for Bioimaging & Sensing.

These research awards are intended to provide opportunities for early career investigators to collaborate with current CEMOs researchers and gain access to CEMOs resources. Each award received $25,000 for one year to target research that builds on the foundation of existing research focus areas, extend the breadth of research in the four research areas, and/or establish bridges between the CEMOs focus areas.

EDEN E. L. TANNER, UNIVERSITY OF MISSISSIPPI

Ionic Liquids To Stabilize And Transport Organic Dye Molecules To Monitor Blood Flow

This project seeks to leverage the stabilization capacity of ILs to substantially enhance the utility of organic dye molecules in biologically-adjacent applications, including imaging and sensing, and demonstrate their potential in blood flow tracking by transporting them through skin. We envisage the work that follows to use mouse models to assess the in vivo use of these dyes in monitoring blood flow.

XUYANG HE, UNIVERSITY OF SOUTHERN MISSISSIPPI

Detection of Newly Emerged Synthetic Stimulants Based on Organic Electrochemical Transistor

The overall goal of this research is to develop novel and reliable OECT-based analytical methods for the rapid detection of synthetic stimulants in forensic samples. In recent years, the abuse of synthetic stimulants has been dramatically increased in the US. According to National Forensic Laboratory Information System (NFLIS)-drug 2019 Annual Report, the phenylethylamine-involved cases represented 30% of the total drug reports, highlighting the need for rapid detection of synthetic stimulants in a way that is simple and robust enough for high throughput forensic drug analysis.

ZHE QIANG, UNIVERSITY OF SOUTHERN MISSISSIPPI

Rapid Ordering Of Conjugated Polymer Films Via Direct Immersion Annealing For Improving Device Performance

This research proposal aims to build on the foundation of existing research focus (especially under RFA1) and address current technology gap through the development of a direct immersion annealing (DIA) technique for rapidly ordering conjugated donor-acceptor polymers, which directly soaks polymer films into a selected mixture of good and marginal solvents.

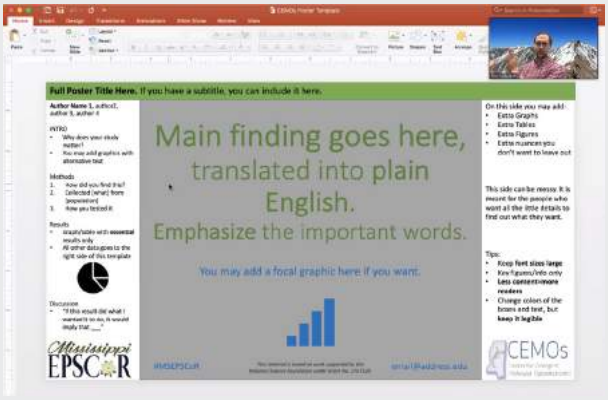
CEMOs

Center for Emergent Molecular Optoelectronics

BEYOND OUTREACH

CEMOs has been hosting a variety of outreach events even through COVID-19. Although in-person workshops have been practically impossible for this multi-institutional project, faculty and industry professionals such as Dr. Ryan Fortenberry, Dr. Eric George, and Dr. Kermit Kwan have made professional development possible for the MS EPSCoR community.

Through a series of lunch-and-learns, CEMOs has been able to provide an array of seminars ranging from how to effectively communicate science to learning about research and development advancements at industry-leading companies.



MISSISSIPPI RESEARCHERS USE DYE TO SPARK REVOLUTION IN MEDICAL IMAGING

The most common size of a brain aneurysm is believed to be about 2 millimeters in diameter.

But, current medical imaging techniques are limited to finding larger aneurysms between 5-10 millimeters, leaving most cases undiagnosed. Advances in imaging technology have the potential to save hundreds of people every year. Mississippi EPSCoR research is ready to make this possible with a dye that will allow medical professionals to find aneurysms down to 1 millimeter in size.

As a result of Mississippi EPSCoR research, a new medical imaging solution may soon be available, which will be more affordable with significantly improved image quality and reduced imaging time. It is almost comparable to having a camera inside a living human, without the invasiveness of endoscopy or surgery.

Dr. Jared Delcamp and Dr. Nathan Hammer from the University of Mississippi and Dr. Colleen Scott from Mississippi State University have been collaborating on the design of an advanced contrast agent that can be used as a dye that is injected into the body for various angiography procedures. While angiography already exists, this new form of dye will bring the procedure and the entire line of medical imaging to a new realm. By changing the contrast agent, this new solution will allow medical professionals to see instant HD-quality images and video from inside their patients. This advancement will revolutionize medical imaging and allow doctors to more effectively identify aneurysms, internal bleeding post-childbirth, arterial blood flow restrictions, and other blood flow related issues.

There is a selection of available medical imaging options in clinical use, such as MRI, CT, Sonogram, and X-ray. Each has a different method to produce images of patients' bones and internal organs. MRIs use magnets and radio waves to help identify abnormal tissue; CT scans and X-rays use high-energy photons to display bone fractures and internal organs; sonograms (or ultrasounds) use sound waves to depict an image; fluorescein angiography is the injection of a dye along with the use of medical equipment such as X-ray or fluorescence imaging systems that require surgery for internal imaging to examine how the dye flows through blood vessels and major organs. These imaging methods are too slow, invasive, or use energy types that cannot image soft tissue and blood flow

Qing Ivy Li, Ndaleh D. N. David, Dr. Jared Delcamp, Christine Curiac, William Meador, & Hunter Shirley

with high resolution in real-time. Currently, it can take anywhere from 15 minutes to a few hours for a quality image, depending on what part of the body is analyzed and the technique used. Even then, professionals may need to take a large number of scans to capture what they need for a diagnosis. Along with the lengthy time it takes to capture images, the currently used fluorescence dyes for angiography available for medical imaging give image quality that is an inferior low-resolution image and therefore ineffective.

Contrast agents are part of a class of materials referred to as cyanines or donor-acceptor-donor materials. Currently used cyanines are either low-resolution materials or require dangerously toxic doses to see clearly, so researchers have been in constant search of improving the contrast agent since before the 1950s.

By designing and characterizing molecules in the xanthene class, Drs. Delcamp, Hammer, and Scott have introduced the first new class of materials to the high-resolution discussion in about 70 years. Xanthene is an organic compound that is used in the new contrast agent. The makeup of the dye with this xanthene contrast agent is called Rhodindolizine. Xanthene has been utilized in many different materials for a very long time. It provides incredible brightness, allowing medical professionals to view images with only a small amount of dye in the system.

The researchers have fine-tuned the compound so that xanthene can be imaged with high resolution for the first time by using it in the short-wavelength infrared (SWIR) spectral region. After thousands of attempts published in literature by the synthetic community, the EPSCoR Center for Emergent Molecular Optoelectronics (CEMOs) researchers have discovered the missing piece in contrast agents that will move the medical field from low-resolution imaging to this proposed instant, high-resolution solution.

Graduate Student Ishanka Rajapaksha & Dr. Colleen Scott

Graduate Student Abdul Kalam Shaik & Dr. Nathan Hammer

The CEMOs research teams have been working together across universities to synthesize the Rhodindolizine and make this discovery. The Delcamp and Scott teams partnered in a divide-and-conquer fashion, each working on perfecting the xanthene-derived compound separately and reporting their findings to one another to speed up the rhodindolizine enhancements. Other EPSCoR research teams make molecule variation predictions prior to testing, developing biological test methods, and making plans to make the dye appear even brighter in images.

Since the CEMOs team first published their novel findings, researchers worldwide have been inquiring about this new material. Investigators from the University of Illinois Urbana-Champaign (UIUC), the Chinese Academy of Science, Harvard, Michigan Medical School, and many others are anxiously anticipating the material's debut so it can be tested in animal models and put to clinical use.

The initial discovery, published in The Journal of Organic Chemistry, has resulted in a U.S. patent application and generated international attention. Now, the teams are working on next-generation designs to increase the imaging resolution even further and increase the duration of time in which imaging can occur.

"We have already seen dramatic improvements in how long the contrast agent survives in practical settings. We are now moving toward designing a suite of materials to give multiple channels for imaging several parts simultaneously," says Delcamp. They plan to fully design the new molecules before widely distributing the materials to the academic community.

This new dye opens up a tremendous number of future possibilities, especially for high-stress situations like blood-flow restrictions or internal bleeding after childbirth when it is difficult to know from where the blood is coming. There is no time to wait for an MRI during internal bleeding, which is currently one of the most significant risks to mothers during childbirth. This technology can allow doctors to see the issue in HD quality, real-time video instead of the guesswork they are using today.

In a similarly stressful scenario, when working with a blood vessel in the heart, doctors must take an x-ray simultaneously as they are injecting the dye since it dissipates so quickly. Where the current dye used to detect internal bleeding dissipates within seconds, this new molecule design will allow doctors to see the dye for a much longer amount of time within the body and more accurately identify and stop the cause of the bleeding.

Not only is the dye proving to be the medical community's next best friend, it further proves its value in the efficiency it provides. MRIs are timely and expensive, but this new product takes a fraction of time compared to an MRI and costs about a tenth of a standard MRI, too, the researchers say.

William Meador Named 2020 Barry Goldwater Scholar

William Meador, senior chemistry major at the University of Mississippi conducting EPSCoR-funded research, earned a 2020 Barry Goldwater Scholarship, one of the most prestigious scholarships in the Natural Sciences.

The Goldwater Scholarship is given every year to the top undergraduate students in the country that demonstrate a strong interest in pursuing research-based careers in the future. Meador was one of approximately 450 undergraduate students across the United States to be awarded the scholarship. While research was not initially part of Meador's plan when he started college, his undergraduate career has inspired and confirmed a future for him in the research field.

Meador is from Carbondale, Illinois, where he was a high school academic scholar. He was at the University of Mississippi (UM) Pre-Medicine undergraduate orientation when he connected with Dr. Jared Delcamp to do chemistry research. Meador began working with Dr. Delcamp during his first semester at UM. Most of this work has been funded by Mississippi EPSCoR RII Track-1: Center for Emergent Molecular Optoelectronics (CEMO) project since its start.

"I had never considered doing undergraduate research before coming to college, so I was really fortunate to be directly approached about the opportunity." Four years later, Meador, now a senior, holds a 4.0 GPA and is on schedule to graduate in Spring 2021 with a Bachelor of Science in Chemistry.

Meador heard about the Goldwater scholarship through the Office of National Scholarship in UM's Honors College. He remembers being able to share the news with Dr. Delcamp immediately, as he was in one of his virtual classes at the time.

"Dr. Delcamp was elated to hear this. He has been an integral component in my development as a research scientist and a huge supporter of me applying to these national scholarships."

The Barry Goldwater Scholarship acknowledges the top undergraduate researchers in the natural sciences throughout the entire United States for their scientific potential and moral commitment. It is thus a recognition of one's outstanding performance throughout their undergraduate careers and recognizable across multiple disciplines over the scholar's entire career. Goldwater scholars receive a financial stipend, but the greatest value is the prestige that remains with the recipient throughout their career. The real benefit is long-lasting recognition as a Goldwater Scholar. This designation will remain with Meador and create new opportunities in his future work.

"This award symbolizes my love for academic research as I have committed most of my undergraduate career to the laboratory. For me, it proves that I am doing the right things and am on the path to succeed in my goal of becoming a teacher-scholar at an R1 institution one day."

Meador has had quite a few accomplishments during his undergraduate career as an author on three publications, all of which have gone to The Journal of Organic Chemistry. Two of those publications, Meador completed through his work on CEMOs. He also became a Taylor Medalist this past spring, which is the highest academic honor at The University of Mississippi.

After graduating, Meador plans to remain at the University of Mississippi and continue working with Dr. Delcamp while earning his Ph.D. in Synthetic Organic Chemistry.

"I intend to pursue a postdoctoral research position at one of the world's premier research institutions and subsequently be a professor at an R1 university where I will manage my own research group and teach graduate and undergraduate courses in organic chemistry."

William Meador, Undergraduate Student

Graduate Student Highlight: Latasha Franklin

Latasha M. Franklin is a graduate student in Chemistry at Jackson State University (JSU) with plans to graduate this Spring, 2021. Originally from Greenwood, Mississippi, Franklin attended Tougaloo College, where she graduated with a Bachelor of Science in Chemistry with a minor in Computer Science in May 2004. After spending several years away from academics to raise and homeschool her five children, Franklin dove back into her studies in fall 2015 at Jackson State University, where she began pursuing a Ph.D.

Franklin became Dr. Glake Hill's first student when he was in graduate school, and she was in undergraduate school collaborating at the Center for Computational Chemistry. Dr. Glake Hill and his wife, Dr. Shonda Allen Hill, became her mentors in her undergraduate studies and would remain a contact for her when she was ready to return to school. Under Dr. Glake Hill's leadership, Franklin had the opportunity to work at the Center for Computational Chemistry in her early academic years. After graduating from Tougaloo, Franklin stepped back from research and academia to be with her family, and Hill accepted an assistant professor position at JSU. Then, in 2015, Franklin decided to apply for a Ph.D. program in Chemistry. Franklin had such a positive experience working at the Center for Computational Chemistry that she decided to pursue her next degree at JSU. Learning that she would be returning to computational chemistry, Dr. Glake Hill was eager to have her work in his lab from the start. By joining his lab, Latasha was able to get connected with the MS EPSCoR Center for Emergent Molecular Optoelectronics (CEMOs) project. Franklin continues to have a close relationship with the couple as a mentee for both her career and home life.

"[The Hills] have impacted my life tremendously by encouraging me to continue regardless of the situation and circumstances. As Dr. Allen Hill always says, 'Moving forward!' which reiterates the fact that even though there are obstacles along the way, the reward is great, so you cannot stop!"

Franklin's work on CEMOs began in December of 2019, receiving compound structures that the CEMOs experimental lab sends to Dr. Hill's lab. They use computer simulation and calculations to determine which structures are more likely to succeed in lab testing. The simulations show the different types of reactions that can occur between the various biochemical compound structures. The list of compound structures with higher probabilities of success is then sent to other CEMOs researchers to use their time more efficiently. By doing this, Hill's lab can see simulated solutions to detecting health issues in the human body. "Working on CEMOS has raised my awareness of the myriad of diseases that could be prevented or alleviated in some form by early detection."

Through the years, Franklin has been involved with various events to encourage STEM (science, technology, engineering, and mathematics) learning in Jackson. She has judged science fairs, visited schools to give demonstrations, helped with outreach events with JSU, and even worked in the Interdisciplinary Center for Nanotoxicity (ICN) with Dr. Allen-Hill for four summers, where she became the Summer Student Coordinator. In addition to these efforts, she encourages her four daughters and son to participate in STEM learning and activities regularly.

In her last year of graduate school, Franklin has a lot to be proud of when she looks at how much she has already accomplished. In addition to having her work published twice this year, and numerous other publications, she has received numerous awards and honors for her academic successes, including being inducted into Alpha Epsilon Lambda and Alpha Kappa Mu Honor Societies. In 2018, she was named the Best Chemistry Graduate Student of the Year by the Department of Chemistry, Physics, and Atmospheric Sciences faculty at JSU.

Despite her academic and research successes, Franklin's most important treasures are family. "By far, my greatest achievement is being a mother to my five amazing children." She says.

As a responsible and nurturing mother, Franklin also acts as a strong role model for her children by balancing classes and research with her home responsibilities. When asked about how she has been able to succeed in school with such a busy home life, she credits her success to her faith in God and the constant inspiration that she receives from her family, friends, the Hills, and her lab family at JSU. All have been contributors to her success throughout the years.

After graduate school, Franklin plans to continue her work in academia as a postdoctoral fellow and eventually a university professor. "My goal is to use the platform of academia to educate underprivileged youth in the areas of STEM. I want young females in STEM always to remember that they are amazing and not to compare themselves to others. You are your only competition."

While Franklin is looking forward to the next chapter of her career, she has a few helpful tips for those considering graduate or professional schools, with the main one being tonot procrastinate. While it is tempting to take time away from school and plan to go back later, Franklin says life simply brings a new set of challenges that can deter those plans if you are not determined. Go ahead and tackle that next step in your education and enjoy the journey, and do not forget to "strive each day to be a better you," Franklin said.

Latasha Franklin, Graduate Student
Photo by Trinity A. Powell

EXTENDED LAB VISIT

Graduate Student Song Zhang at a national American Chemical Society meeting where he presented the results of his research.

Graduate student Song Zhang has had the opportunity to visit multiple national labs through EPSCoR. One of those labs was the Oak Ridge National Lab (ORNL) in Oak Ridge, Tennessee. Zhang is in his fifth year of graduate school at the University of Southern Mississippi (USM), where he is researching the physics behind semiconducting polymers with Dr. Xiaodan Gu. As a part of his research studies for CEMOs, he travels to various labs with specialized equipment to speed up the results.

“I brought back new data that has not been produced by anybody and anywhere else. This knowledge generated in the national lab was essential for our research group to understand our polymer materials from the molecular level. This knowledge will be written in papers and shared with the entire community.”

The national labs are equipped with many top-notch technologies and expensive equipment that are not affordable for a standard university research lab. Many national labs also have focused facilities, such as synchrotrons, neutron facilities, and supercomputer centers. The work performed in the national lab is more regulated than that of the university. Due to the higher amount of funding expenses, volume of personnel flow, and lab safety recommendations, these labs require more administrators supervising the facility. Researchers are also required to obtain approval before running their experiments. Zhang reflects that while the national lab has excellent equipment that helps propel projects forward, “at the university, we have more freedom to try different ideas.”

In addition to helping the research team’s current projects along, Zhang expressed how helpful it is to tour the rest of the lab facilities and consider future research opportunities.

“Moreover, these experiences allow us to give other researchers suggestions if they have questions about the techniques or instruments we used before.”

Some other labs that Zhang and other CEMOs researchers have visited throughout the project include Lawrence Berkeley National Lab (LBNL), Brookhaven National Lab (BNL), and the Stanford Synchrotron Radiation Lightsource (SSRL). As a seasoned lab visitor, he recommends discussing your experiment plans with the staff scientist so you can begin work when arriving at the facility. He also suggests prioritizing experiments in case of equipment setbacks and making sure you are well-rested and well-fed for a weekend full of lab tests!

Q & A WITH NEW FACULTY MAHESH GANGISHETTY

Some of the investments EPSCoR has made to the state of Mississippi include the hiring of new junior faculty at each of the four research institutions. Dr. Mahesh Gangishetty is one of the newest members of the Center for Emergent Molecular Optoelectronics (CEMOs). He recently joined the team at Mississippi State University as an assistant professor in the Department of Chemistry.

Let's start off at the beginning- Where are you from and how did you get into your research area?

I'm originally from the southern part of India. I was born and brought up in a small village until high school, then moved to a city where I did my bachelor's. I first got attracted to chemistry doing a lab experiment in high school. We were working on basic titrations to find out an invisible compound in a solution by observing color changes. I could not believe that we could find unknown things by making them visible to our eyes using a simple and straightforward reactions. I remember asking, "can we really do that?" Then, I majored in math, physics, and chemistry for my bachelor's degree. I wanted to be an organic chemist and determine how reactions would work in the flasks. I started reading books on fundamentals of chemistry, and my interest kept growing. From one my friend's advice, who has seen my enthusiasm in reading these chemistry books, I went ahead and explored opportunities for higher education and research. I went to the Indian Institutes of Technology (IITs), one of the Indian premier institutes, to get my master's in chemistry. After that, I got my Ph.D. in Canada and had a postdoc position at Harvard. Now I'm faculty here at Mississippi State.

What brought you to the US?

After my Ph.D., I started looking for postdoctoral positions in research group where I could apply my skills and knowledge and contribute the field. Unlike applying for thousands of positions to get one job, I applied to very specific positions by carefully going through the research groups and making sure that I can succeed in their groups. I have looked into positions where my expertise matches with their research and at the same time, I can learn some new skills. I found research in Congreve Lab lead by Dan Congreve at Harvard interesting. He published a fantastic article (DOI: 10.1038/NPHOTON.2015.226) that came across my desk. I started reading it, found it as very interesting then I started approaching them by proposing various ideas as future directions to this work. Luckily, Dan liked my ideas and offered me to discuss my ideas. It took about six to seven months to go through the hiring process. And then, he finally chose me after a rigorous interview process; that was an amazing moment. I'm very pleased with that. In Jan 2017 I moved to Boston, USA, and started my postdoctoral fellow at Rowland at Harvard University.

How did you get involved in this EPSCoR project? Where does your work fit in with the project?

I was hired specifically for the EPSCoR funded research on CEMOs (Center for Emerging Molecular Optoelectronics), which is focused on hybrid materials for optoelectronic applications. Throughout my career I have been working on

optoelectronic materials and devices. I spent several years in my Ph.D. and postdoc on understanding the fundamentals of optoelectronic materials and build efficient devices depending on their properties. So, when EPSCOR-CEMOs came across my path, I started looking into the details and figured that I can be a very good addition to the research proposed in this project. I have noticed that many colleagues at Southern Mississippi and Mississippi State, are working on exciting materials for the optoelectronic applications. Some are good at making molecules/ polymers, and some faculty are good at studying them. However, there is clearly a missing expertise on the devices, and I am a device-rich guy. Therefore, I realized that my expertise on studying these materials and applying them in devices like solar cells and LEDs, and upconverting systems is a perfect addition to the existing ESPCOR team. My expertise lies on understanding how energy transports between individual materials and assembling them appropriately for energy conversion applications. By working in this EPSCOR team, I will get an opportunity to study with variety of small molecule, polymers and inorganic materials and explore them in devices.

What has helped you be successful?

Coming from a small village in India, I've gone through many hurdles and challenges to become a researcher and teacher in the USA. I have never imagined that I will be crossing the countries to pursue my education, I always used to be scared to cross my village and travel in cities within India. Believe me, my passion and determination towards science gave me all the courage to cross the oceans and reach here. Throughout this journey, I have learned to be patient and focused despite many challenges I faced. Generally, with fast growing technology, we are getting used to immediate results and often we lose hope and patience easily. Fortunately I have never lost hope and I kept myself up with motivation and energy reminding myself that I am doing all this for what I love the most, which is "science". The beauty of the science field is you get a privilege to do what you like and what you want. The idea of using scientific tools and knowledge to target the challenges in the world is really amazing. I always get excited by seeing new and emerging materials and technologies that are emerged from scientific inventions.

Have you had a mentor or role model through all of this?

Throughout my career, I've had fantastic mentors. Two of those were in my Ph.D. and my postdoc. I would say they have a strong influence on my research style, character and my way of thinking. I couldn't have overcome all the hurdles and challenges without their support and encouragement. They facilitated everything that I need to progress in academic life such as from training me as researcher in the lab to presenting and networking. Presenting science and networking in addition to working in the lab are most important things that every academic must know and learn. They help me to overcome my shyness and inferiority and trained me on interacting with people and showed me how to make them excited about science and whatever you do. Without them, I wouldn't have reached this far, cannot imaging where I would be right now.

What advice would you give to younger kids who are just starting in STEM?

For me, coming from where I was in India in a small village, I never imagined I can be a scientist and teacher one day. But here I am now, which shows that things are possible without being that challenging. One thing I would advise the younger kids is that "you should never ever lose the hope and the passion" on what you love the most, keep working hard and work towards the goal; never give-up. The only thing that kept me moving ahead, despite enormous challenges in my life, is my love and passion towards science. One of the biggest problems now is we are getting too used to having immediate results and highly dependent on social media such as Google to find an answer. Believe me in real life things do not work in that fast, you learn effectively more only when you work hard. In addition to passion and enthusiasm if you are hardworking, and patient, things will come on your way and you will never regret that you waited so long to get them.

Mahesh Gangishetty, Assistant Professor

SCIENCE ADVISORY BOARD MEMBER HIGHLIGHT: DR. KATE BEERS

Mississippi EPSCoR advisory board member Dr. Katheryn (Kate) Beers was born in the Twin Cities in Minnesota and grew up in Northern Virginia near Washington, DC. She currently serves as a Group Leader over the Polymers and Complex Fluids Group in the Materials Science and Engineering Division at the National Institute of Standards and Technology (NIST) in Washington, DC.

How did you become interested in science and polymers?

I spent my freshman year at Villanova University and was an honors student there, studying languages and history, and had done a lot of writing as an AP student in high school. In the honors courses there, I thought I was a pretty good writer, but I decided to transfer to William & Mary for my sophomore year and quickly realized that writing skills are relative to your peer group. It was a rude awakening that I was just not skilled at the same level as many of my classmates were. At the same time, I always had a really easy time with math and science. Those subjects had come more naturally to me, and I had an amazing chemistry professor. I had to fulfill a chemistry requirement, so I took the chemistry class for chemistry majors. I fell in love with the subject just from the way he taught and decided to change majors. I never regretted it.

I went to graduate school at Carnegie Mellon, and again, I thought I was going to study something completely different and ended up switching my focus area in my second year to polymer science. I completed a master's in polymer science there and worked with Krzysztof Matyjaszewski right when ATRP (atom transfer radical polymerization) was exploding on the scene of polymer science. It was a very fun and exciting time and a very challenging time. While I was there, I met my future husband, who just so happened to be permanently stationed in the Washington DC area. I never in a million years thought I would come back to this area, but you know, all of a sudden, I needed to find work in Washington. NIST was the absolute best place to do polymer science in the region, and I got lucky with an NRC (National Research Council) postdoc there. At the time, I wasn't sure I wanted to stay in research. Graduate school had been very, very challenging. I applied to law school, got into law schools, and was thinking about being a patent lawyer. But, I really enjoyed the NIST environment and the NIST culture and chose to stay in research. And now I've been there for about 20 years. I had a bunch of different jobs at NIST and a bunch of different roles.

When you say you got into polymers when it was big, what do you mean by that?

So, there was a particular kind of polymerization called atom transfer radical polymerization, or ATRP. The gentleman that I did my graduate work with is generally considered the discoverer or the inventor of that method. It really transformed the way we make polymers and who can make advanced polymers. It expanded the toolkit for people that were non-experts in the field and has been quite transformative over the last 30 years in science. There've been other methods that have been developed since then that gave people the same power of control over their chemistry, but that was really the first one where pretty much anybody could make sophisticated, functional, and very smart molecules without formal training in organic chemistry. That has been the focus of the field ever since.

I was naive at the time, and I just sort of stepped into the group and got lucky. But it was an exciting time to be in that research group, working in those areas with a bunch of different people that have all done interesting things. Kris Matyjaszewski is quite famous in our field.

Dr. Katherine Beers, NIST

And you are still researching polymers today?

I do, yes. Now, I have multiple hats. The job I've been doing last year and continuing into this year is helping us build a program in the circular economy. Many people have heard about the plastics waste challenge, whether it's about plastic and the environment, the accumulation of plastics in various places, or the international trade disruption. Certain countries that have been accepting low quality, recycled materials for a long time now are no longer wanting to process them, and really disrupting the way the first world has looked at their waste problem for 40 years. That presents a lot of challenges, both to improve our stewardship of the environment and also to take responsibility for getting all of the value out of our 'waste' that we can. I've been helping NIST figure out what we can do to help multiple communities do that better, whether that's other agencies and their mission spaces like NOAA (National Oceanic and Atmospheric Administration) and EPA (Environmental Protection Agency), or the industries that we've always served historically, as part of the Department of Commerce. There's a fundamental science side to it, an economics and market side to it, and it's a fun and exciting space to be. I do still also have a postdoc, and I still contribute to a project team because I haven't completely stepped away from the lab, but that's become a smaller part of my day to day work.

How did you get connected with Mississippi? And if you don't have any connections to Mississippi, how did you get involved in Mississippi EPSCoR?

I don't have any connections to the state proper, but the polymer science program at the University of Southern Mississippi (USM), in particular, has a long history of producing great polymer scientists, and many of them have done postdoctoral assignments or become permanent staff members of NIST. I had a couple of postdocs from USM, and one, in fact, who became faculty and has been very successful at USM. I've always had close connections to the department there and served on other advisory committees and such, so I was very happy when they asked me to serve on the EPSCoR panel.

I heard that you were a part of the reverse site visit. Can you tell me about that experience? How does that take place?

That took place back in the spring. I have participated in other, more recent, reverse site visits where I, for example, went to the National Science Foundation and sat on a panel for a day or two. There, I listen to presentations from groups. The virtual panel was good, but I think that the in-person panels usually are a little more valuable because there's more opportunity for interaction. We were also doing that at a time right when everybody was trying to figure out how to translate all these formats into the virtual space. Things like poster sessions for students still remain a challenging thing to capture in this remote environment. But, it's really clear that this is a strong team of great researchers, and they have some interesting matchups of their teams across the universities. I think there's a lot of potential for that to have a huge impact.

"The future of our field is this connection to data, computation, and predictability"

"We need more success stories in that space as a nation, not just as an EPSCoR program"

What do you find is most exciting about the Mississippi EPSCoR project from what you have seen so far?

I think it's the connection, but more specifically, it's the multidisciplinary connection to theory, as well as the materials and the device performance engineering side of things. I think the future of our field is this connection to data, computation, and predictability. I felt that the team was trying to tackle that head-on, and it was transparent about the big challenges in that space to get meaningful resources together to do more predictive learning about how things work. That, I think, is exciting for the team.

Do you see any room for growth or future opportunities that the project should consider? Maybe some opportunities that Mississippi EPSCoR could take on and feature?

Early on in these programs, there's almost always a strong industrial partner that's brought in to bear on these teams and a lot of good intentions on how to connect to industry. One advantage that the Mississippi EPSCoR program has is it has got a university in an academic environment that has partnered with industry successfully, over and over again. And, it's in a new way of partnering with this very large and complex technology space. I think there's an opportunity for it to have a much bigger impact than it historically has had, with a single partner model by bringing in the multidisciplinary, multi-department, multi-program approach to its industrial partners. I think that's super challenging for anyone, but I hope that the project is able to be successful and strengthen that partnership model because we need more success stories in that space as a Nation, not just as an EPSCoR program. Everybody can benefit from seeing places where that works and works well.

Do you have any advice for women or young girls in STEM?

Just try to have as much confidence as you can and don't let people get to you. Try to be kind and forgiving, but also stand your ground. That can be a hard thing to balance, but just because you know what you're doing, you're smart, and you have ideas does not mean that you have to be mean, nasty, or any of these other stereotypical kinds of things women get labeled. Just be strong and stand up for yourself and stand up when you see other people also being treated in ways that you don't like because we need to speak up more, but we need to speak up more in a constructive way that represents everybody. I think women are in a better position than a lot of other groups in science right now, you know, which is unfortunate. As much as we're struggling, we're not struggling as much as some other folks are, so remembering to look out for everybody is really important.

"Everybody can benefit from seeing places where industry and science work well."

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Mississippi EPSCoR
P.O. Box 6343
Mississippi State, MS 39762
662.325.3629 | www.msepscor.org

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