



FINAL NEWSLETTER

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REFLECTIONS

Since 2005, the Air Force Research Laboratory's (AFRL) Minority Leaders Program (MLP), now referred to as the AFRL Minority Leaders Research Collaboration Program (ML RCP), has been successful in bringing together talented students and faculty members from across the United States to work with Government scientists and engineers in a mentor/protégé' structured environment. Through this partnership, research capabilities and educational opportunities at Historically Black Colleges and Universities and Minority Institutions (HBCU/MIs) were enhanced as well as a strong academic network formed. Basic and applied research efforts in support of AFRL have focused on advancing critical Air Force and national research areas such as nanotechnology, electro-optical materials, composites, and manufacturing technologies.

This program began in 2005 with eight schools involved and has grown to its current status of 37 university participants. Hundreds of university professors and students from undergraduate to doctoral candidates have been involved in the program throughout its existence. Contractual support has primarily been provided to the Materials and Manufacturing and Sensors Directorate of AFRL, but additionally the Information, Aerospace Systems, and Airman Systems Directorates have also participated. Universal Technology Corporation, a small business (Dayton OH), has served as the primary contractor for this effort since 2005 responsible for the execution of the program. Assisting UTC was Clarkson Aerospace, a small disadvantaged business from Houston TX, who coordinated the funding to the universities and provided additional technical and management support. The current contract comes to an end March 2019. This program has primarily been funded with Congressional intent funding. The Government has been working diligently to continue this program and are working through several options. For those of us involved in the program, it has been a privilege and honor to work with the Government and the schools, but most importantly the students. The intent of the program is to energize minority students who were US citizens to pursue studies in the areas of science and engineering. Through the years, we have seen that happen. Many students had the opportunity to visit Wright-Patterson AFB and Rome NY and work side by side with Government scientists and engineers during the summer months. Consistently at the end of their internships, students expressed their excitement to continue on with the research at their schools and were contemplating futures in the Science and Engineering spectrum – whether it be as a civil servant, DOD contractor, or industry related field. The reinforcement of the significance of these career fields has more than been prevalent throughout the existence of this program. Students were given access to amazing research laboratories and researchers at these locations and were able to participate in activities that otherwise might not have been possible. Likewise, faculty members across the United States also benefited from working with AFRL and welcomed the opportunities provided their students. This program also resulted in increased grants and contracts being leveraged by the ML RCP for the schools. For AFRL, this program provided new sources of quality research and increased the pool of prospective candidates for employment while giving AFRL opportunities to increase diversity in their workforce. Working with students and faculty members from varied backgrounds, contributed to innovative thoughts from culturally and scientifically diverse sources.

In addition to the efforts and opportunities this program afforded so many, we also want to thank the many, many AFRL researchers who took their time and expertise to share with the many students. In addition to summer internships, AFRL researchers participated in monthly and often bi-monthly teleconferences reviewing the project work and offering

(Continued on Page 2)

(Reflections continued)

assistance as needed. This program could only have been successful with the dedication of these individuals as well as the faculty and university administrators. This program was a strong collaboration of various individuals who made it work. UTC would like to thank Ms. Asheley Blackford who served as the Government lead program manager for the overall contract and for the AFRL Materials and Manufacturing Directorate as well as Dr. Reginald Cooper (former ML RCP participant) who oversaw the Sensors' and Information Directorates portion of the work. These individuals worked tirelessly to ensure the best possible results of the program.

Through the years, working and business relationships were built and reinforced, but most importantly friendships were made that will last forever. We would like to take this opportunity to wish all students the very best as they continue through their careers. We know that the ML RCP had a profound impact in the lives of these students and we feel privileged to have been a part of it. Best wishes to all for continued success. Please see the following for a few words from our partners on their thoughts on the program.

Mr. Joe Sciabica*President,**Universal Technology Corporation***Ms. Linda Lange***ML RCP Program Manager**Universal Technology Corporation*

In 2005 the USAF initiated a pilot research and development program to increase Historically Black Colleges and Universities and Minority Small Business participation within AFRL. Thirteen years later the USAF MLP program is still the largest major university, HBCU, small business research collaboration within the USAF. What made this program successful when other programs had failed in the past were:

- 1. Guidance of dedicated program managers at the Air Force Research Laboratory.*
- 2. Universal Technology Corporation (UTC) - A prime contractor with the working knowledge of AFRL.*
- 3. Clarkson Aerospace Corporation - A minority small business with DOD experience and an acute working knowledge / credibility with many HBCUs.*
- 4. HBCUs - Professors that could perform DOD quality research at AFRL and work with major mentoring universities like Texas A&M, University of Dayton, and Rice University to name a few.*

This program would not have been the success that it is without the total commitment of each one of these entities.

Clarkson Aerospace Corp*Integrating Subcontractor*

It is a great honor for UTC to have been associated with the ML-RCP program since its inception. In that time, we've worked with hundreds of students who have had their lives changed through the opportunity to work with world-class researchers at the Air Force Research Laboratory; and they have gone on to change the world through their own work. The research done by ML-RCP students is beyond impressive. The students, the schools, and the country, are better for it.

Mr. Wendell Banks*Director, Airbase, Sensor, and**Cyber Systems**Universal Technology Corporation*

On behalf of the Materials and Manufacturing Directorate (AFRL/RX), I feel honored and privileged to have served as the Program Manager for the Minority Leaders Research Collaboration Program. It was rewarding to work with the students, professors, and our AFRL mentors. I was able to witness first-hand the many opportunities presented to students who otherwise may not have been exposed to this type research. It certainly reinforced the necessity of programs such as this to help students realize the many possibilities STEM careers have to offer. I would like to thank all the AFRL/RX scientists and engineers that I have worked with through the years on this program and please note how appreciative I am of your guidance, knowledge, and willingness to help support the program!

Ms. Asheley Blackford*Program Manager, ML RCP**Materials and Manufacturing**Directorate, AFRL*

As I reflect on this journey one word is woven through the fabric of its existence, "OPPORTUNITIES:" opportunities created and leveraged, ongoing, and opportunities to come. I have been blessed to witness this at many stages and in various roles during this program. The efforts of many individuals should not be understated. You the students, professors, industry partners, and the government team have consistently ushered in a spirit of diversity and inclusion into STEM, not only at AFRL, but for our nation. The evidence of this is in the many testimonies shared over the years, but our work is not done.

One of the things that I have come to realize is

(Continued on Page 3)

(Reflections continued)

that the fundamentals of our research are not exclusively rooted in the science, math, and physics that defines it, but includes the way we view the world around it. The more diverse and inclusive our views the better our research. So be encouraged and continue to provide and leverage opportunities to diversify STEM. Thank you and I look forward to what the future holds.

Dr. Reginald Cooper
Program Manager,
Sensors Directorate

The ML RCP program has provided Morgan State University an opportunity to build a stronger research thrust in Intelligent Communications. It has been a great support for students pursuing undergraduate and graduate degrees. The funding provided enabled students to present work at technical conferences, to network and interact with AFRL engineers and enabled faculty to leverage funding to create new research pursuits in IOT.

Dr. Michel A. Reece
Interim Chairperson
Department of Electrical and
Computer Engineering (ECE)
Morgan State University

Networking, persistence, and hard work are the crucial ingredients to advancing a career. ML RCP is our passport to advance a career by being involved in the research.

Dr. Yenumula B Reddy
Professor, Program Coordinator
Department of Computer Science
Grambling State University

It is hard to put in numbers the impact that the ML RCP had, particularly on students. Graduate students had the opportunity to get their graduate degree while in direct collaboration with outstanding researchers in other Universities and at the AFRL. They became leaders in a research topic they knew little about when they started and spread their knowledge nationally and internationally while learning the art of scientific communication. Undergraduate students from Louisiana Tech and Grambling State, a majority from underrepresented groups, had the opportunity to do research either at AFRL over the summer or working at Louisiana Tech, hand-in-hand with graduate students, getting a real feeling for what Graduate School is about. Finally, it is hard to overlook the impact it had in my career. The ML RCP has allowed me to collaborate and feel as an equal to highly regarded researchers and was undoubtedly a big factor in the process leading to my promotion to full professor. We need to continue having programs like this; money is never better invested than

in the education and training of our youth, no effort is too much if devoted to leveling the field for our future generations."

Dr. Pedro Derosa
Larson Professor of Physics
Louisiana Tech University

The MLP has been transformative at Chaminade, providing research opportunities and funding cutting edge faculty projects. The MLP investment has been leveraged to obtain funding from NSF, NIH, DOD and DOJ, putting Chaminade on the map in research and supporting student and faculty scholarship. Recently we welcomed an alum of our MLP program, now Dr. Rylan Chong (PhD in Computer Science, Purdue 2018) to join us as a faculty member and lead in our brand new BS in Data Science. Rylan's return speaks to the launchpad that the MLP has been for our students into successful graduate careers.

Dr. Helen Turner
Dean of Natural Sciences and
Professor of Biology
Chaminade University

Working with AFRL and UTC on a project of mutual interest has been one of the highlights of my life in the past year as a professor in TAMU. The program is designed to nicely bring a combination of odds together, such as: the desire of a professor to try high risk-high reward projects, the desire of the whole team to tackle most fundamental questions and seek for a societal impact there, and with that, the dire need of accepting failures with a smile. A failure which is not the end of the story but lesson to be learnt and a new beginning for more ambitious goals.

Dr. Mohammad Naraghi
Department of Aerospace
Engineering
Texas A&M University

The ML RCP has been a wonderful opportunity for our students to engage in research that interests AFRL and many students have been able to take summer internships at AFRL. I am very grateful to AFRL for this program.

Dr. John Ball
Assistant Professor
Electrical and Computer Engineering
Mississippi State University

(Continued on Page 4)

(Reflections continued)

The ML RCP program has been a huge success for students at UTSA. Among the many students that participated in the program, one of our former students, David Wagner, completed his PhD and is now employed at NASA Langley in a Computational Materials position. Another, Wes Fielder, completed his MS degree and is employed at StandardAero, and a third student, Eli Iglesias, is completing his PhD at UTSA. Several undergrads are now in graduate school. In addition, a large percentage of students took the opportunity to work at AFRL in the summer to gain valuable experience working with world-class materials researchers.

Dr. Harry Millwater

Professor of Mechanical Engineering
Samuel G. Dawson Endowed
Professorship
University of Texas at San Antonio

The collaboration between the University of Texas at El Paso (UTEP) and AFRL provided unique and excellent education, training and research opportunities to the UTEP students that are from historically underrepresented minority (URM) groups. Specifically, UTEP students received hands-on laboratory experience, broader exposure to the cutting edge research and technologies, research mentoring by the AFRL scientists and engineers, and finally the opportunities for networking and professional development. In addition to accelerating scientific excellence, the collaboration also helped the junior and mid-career faculty to become leaders in their respective research field, most importantly in the area of advanced materials science and engineering.

Dr. Ramana Chintalapalle

University of Texas at El Paso

Everyone involved over the history of the Minority Leaders Research Collaboration Program (ML RCP) should take pride in the impact this program has had on the students. Several of these young men and women have had their lives changed forever. How these "changed lives" impact other lives in the future is something we will never know. What we do know is that this program has provided the foundation to allow them to exploit their potential to its fullest.

Dr. Charles Browning

Torley Chair in Composite Materials
Chair, Department of Chemical and
Materials Engineering
University of Dayton

I have been privileged to participate in the program for a relatively short time, but the experience has been transforming for me...to be a small part of the process: quality students doing Air Force - pertinent research, guided by dedicated faculty and Air Force lab leaders, in a nurturing environment. Numerous times I observed collaborations across all, or many, of these process partners that made for even greater value. The ML RCP is truly a best practice that should be expanded across the Air Force and shared beyond.

Mr. Bob Rapson

Program Manager
Universal Technology Corporation

It has been a pleasure to work on the ML RCP, coordinating research and development collaborations at the universities, in the AFRL labs and at some unique test sites. The under-lying purpose of the ML RCP has always been helping a diverse group of undergraduate and graduate students develop their potential. This program has immensely influenced many of the universities in expanding and sustaining crucial capabilities. The success of the program stems from the people-connections among AFRL, the universities and contractors.

Mr. Roger Rucker

Program Manager
Universal Technology Corporation

The Minority Leaders Research Collaboration Program (ML/RCP) provided an opportunity to advance equal opportunity in higher education, strengthen the capabilities of minority institutions, and transform the workforce of the DoD. The DoD requires access to the best trained scientists and engineers who can solve real-world problems, providing a technological advantage to our soldiers. By participating in the ML/RCP, students were provided with the opportunity to experience world-class scientific research environments in which they could build their skills as researchers. The program inspired the universities to investigate several new research areas. As a result, several new innovative research centers were created, research equipment was enhanced and purchased. Faculty research efforts were also increasingly recognized, inspiring over 700 publications. More than 25% of the participating professors attributed receiving tenure to their participation in the ML/RCP and most importantly over 780 students and 130 professors are now solving those DoD real-world problems!

R. Douglas Hutchens, PhD

Former, ML RCP Program Manager
(UTC, Retired)

(Continued on Page 11)

MINORITY LEADER RESEARCH COLLABORATION PROGRAM 2018 SUMMER INTERNS

The Air Force Research Laboratory (AFRL) welcomed 32 students for the summer in support of the Minority Leaders Research Collaboration Program (ML RCP). These students worked in the Materials and Manufacturing and Sensors Directorates at Wright-Patterson AFB as well as the Information Directorate, Rome New York. It is rewarding for the students to be able to spend time with the dedicated mentors at AFRL. A special thanks goes out to all those individuals who helped with the students: Ms. Asheley Blackford, ML RCP Program Manager and Mentors: Dr. Ruth Pachter, Dr. Shantee Pacley, Dr. James Blackshire, Dr. Hilmar Koerner, Dr. John Jones, Dr. Josh Kennedy, Dr. Ajit Roy, Dr. Ben Leever, Dr. Dhriti Nepal, Dr. Neil Murphy, Dr. Jonathan Spowart, Dr. Craig Przybyla, Dr. Gail Brown, Dr. Rajiv Berry, Dr. Pat Golden, Dr. Tim Pruyn, Dr. Pat Dennis, Dr. Eric Payton, Dr. Reji John, Dr. Benji Maruyama, Dr. Dan Berrigan, Dr. Michael Groeber, Dr. Edwin Schwalbach, Dr. Matthew Dickerson, Dr. Philip Buskhol, Dr. Adam Pilchak, and Dr. Augustine Urbas – all from the Materials and Manufacturing Directorate. Mentors from the Sensors Directorate include Dr. Reginald Cooper, Dr. Kenneth Hopkinson, Ms. Aji Mattamana, Mr. Trevor Bihl, Dr. Ben Seibert, Dr. Emily Heckman, Mr. Todd Jenkins, Dr. Chris Paulson, Ms. Beth Sudkamp, Ms. Lisa Jones, Mr. Steve Hoberty and Mr. Andrew Rice. Mr. Rob Riley, Mrs. Juanita Riley, and Dr. Marcus Pendleton from Rome NY Information Directorate served as mentors for three ML RCP students. We appreciate Ms. Blackford and all the mentors for the many hours of dedicated time they provide to these students.

More information on the students can be found below:

Student Researcher:

Darrell McClendon

School:

Jackson State University

Major:

Computer Engineering

Classification:

Freshman

Area of Research:

Quantum Computing

Mentors:

Dr. Reginald Cooper



My work this summer was on the topic of Quantum Computing. I explored the origins of Quantum Computing along with advanced details associated with the larger field of Quantum Mechanics. This work included theoretical possibilities of Quantum computing along with what is possible today. I was tasked with explaining the concept to my mentor in terms more relevant to his work. In order to accomplish this task, I had to be familiar with the fundamental and advanced concepts of Quantum computing as well as his work in radar technology. Although the field is majorly untapped at this current time, I enjoyed being on the forefront of this research. The experience was enjoyable and the work was challenging. My connection with UTC and Mrs. DeAnna Brown made the experience hassle free, which allowed me to focus on my work.

Student Researcher:

Michael Banks

School:

Clark Atlanta University

Major:

Computer Science

Classification: Junior

Area of Research:

**Reinforcement Learning,
Q learning, and Python**

Mentors:

Ms. Juanita Riley and Dr. Marcus Pendleton



My project for AFRL was geared towards mission assurance for UAVs. Dr. Pendleton believed this could be done by providing the UAVs with a decision-tree based Q-learning algorithm. With that being said, I was asked to implement the algorithm on a 2D simulation, Pac-man, in python2.7. In addition, I would have to research and learn on the topic of reinforcement learning. Although we still have some ways to go before testing on UAVs, I was able to complete the implementation of the algorithm. I really enjoyed the internship at AFRL. Receiving a guiding hand, I was able to gain valuable experience. I was doing challenging work. Also, I made long lasting relationships with fellow interns and mentors. With this internship making such a heavy impact on my future, I will forever appreciate it.

(Continued on Page 6)

(Minority Leaders Research Collaboration Program
2018 Summer Interns continued)

Student Researcher:

Stephen Bratz

School:

University of Texas at
San Antonio

Major:

PhD Mechanical
Engineering

Classification:

1st Year PhD Student

Area of Research:

Computational Crack Propagation

Mentor:

Dr. Arturo Montoya

This summer served as an introduction for the research in my PhD program. The basis of my research is computationally dealing with crack propagation. For this, we started with learning as much as possible about fracture mechanics within a short period of time. Next, I learned about UEL's or user element routines in ABAQUS. A UEL is a user subroutine that does all of the calculations you require for a specific series of elements in ABAQUS. To make this UEL, I had to learn how to use and utilize FORTRAN. Finally, the goal was to apply the fracture mechanics learned earlier in the summer via FORTRAN to the ABAQUS model in order to get the desired results. Although the research I will be doing in the future consists of this on a much larger scale, this was a great introductory experience and will provide a solid platform to build upon.



Student Researcher:

Sydney Brooks

School:

Jackson State University

Major:

MS Computer Science

Mentor:

Dr. Reginald Cooper

This summer I worked with Dr. Cooper exploring the security vulnerabilities of quantum computing and quantum networks. I also tested quantum circuits using the IBM Quantum Composer. The program is an amazing opportunity. I would advise any one able to participate



to do so at least once. Everyone at UTC is amazing and made sure we were well taken care of during our time with them.

Student Researcher:

Hugh DeJarnette

School:

LA Tech

Classification:

CAM PhD Candidate

Area of Research:

Nanomaterial Simulation

Mentor:

Dr. Josh Kennedy

During my time here, I contributed to multiple projects, from computer vision analysis of carbon fibers to particle modeling for optical scattering. For one project, I collected and analyzed visual microscopy data to gather length distributions of carbon fibres in a direct write 3D printer ink. For the other I developed a COMSOL Multiphysics model for the optical scattering responses of a dielectric clad gold nanorod for use as a temperature sensor.



Student Researcher:

Leonardo I Gutierrez Sierra

School:

The University of Texas at
El Paso (UTEP)

Major:

Mechanical Engineering

Classification:

PhD Student

Area of Research:

Additive Manufacturing, Composites,
Robotic Systems

Mentors:

Dr. Hilmar Koerner

This summer I worked in the Materials and Manufacturing Directorate at AFRL in the composites division team. Given my background, I was placed in a project regarding the additive manufacturing (AM or 3D Printing) of thermosetting polymer matrix composites (PMCs). These PMCs are epoxy reinforced with carbon fiber to enhance mechanical properties such as strength and elastic modulus. The goal of the project is to create

(Continued on Page 7)



*(Minority Leaders Research Collaboration Program
2018 Summer Interns continued)*

said PMCs via 3D Printing and be able to use them in the aerospace field for brackets, fixtures, etc. The advantages of using AM are to create complex geometries that are not simple to create via conventional manufacturing methods and reduce production time.

Student Researcher:

Samantha Knoth

School:

University of Dayton

Majors:

**Chemical Engineering (BS);
Bioengineering (MS)**

Classification: Senior

Area of Research:

Bio-Energetic Materials

Mentors:

Dr. Patrick Dennis and Dr. Joseph Slocik

This summer I did research at AFRL/RXAS working to scale-up the production of a biomaterial that when loaded with nAl becomes a bio-energetic material. I developed a protocol to produce this biomaterial in larger quantities from the mg scale to the g scale. I produced 14.8 g of the biomaterial this summer and it is ready to be loaded with nAl and sent to the Munitions Directorate for further testing.



Student Researcher:

Nanthakishore Makeswran

School:

University of Texas-El Paso

Major:

Mechanical Engineering

Classification:

2nd Year PhD Student

Area of Research:

Engineering Thin Films, and Nano-Structures

Mentor:

Dr. John Jones

The summer research focused on the creation of multilayer thin film structures for the creation optical second harmonic generation with application in sensor technology and telecommunications. Pulsed laser



deposition was learned and applied to the creation of these film structures and was later supplemented with instruction in the use of magnetron sputtering to overcome physical limitations of the PLD system in regards to certain materials chosen for the layers. Finally in-situ ellipsometry and X-ray photoelectron spectroscopy techniques were elaborated on and used to analyze both the created films as well as other pre-existing samples.

Student Researcher:

Chris Barrett

School:

University of Dayton

Major:

Mechanical Engineering

Classification: Senior

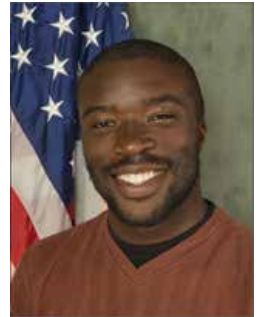
Area of Research:

Preceramic Polymers

Mentors:

Dr. Tim Pruyn

My work this summer was examining preceramic polymers used in additive manufacturing. As producing ceramic parts using green powder compact is somewhat expensive and can also end up with a misformed part, the process of using additive manufacturing as an alternative was investigated. The process is conducted by taking a polymer with a silicon and carbon backbone, 3D printing it into a shape, and then heating the polymer up to extremely high temperature, which turns the silicon carbon back bone into a Silicon Carbide Ceramic.



Student Researcher:

Ross Wise

School:

Grambling State University

Major:

MS Computer Science

Classification: Sophomore

Mentors:

Dr. Reginald Cooper

This summer, I worked on Wright-Patterson Air Force Base at Air Force Institute of Technology (commonly known as AFIT) under Dr. Kenneth Hopkinson. During my time here, I was able to gain experience in Machine Learning; a field, specializing in the development of neural networks, or programs that



(Continued on Page 8)

*(Minority Leaders Research Collaboration Program
2018 Summer Interns continued)*

are capable of accomplishing certain tasks independently from humans. After learning the fundamentals, as well as some of the more complicated aspects, I was given the task of creating my own neural network, capable of locating a single object in an image, finding that same object in an image where the object has moved. Then, getting it to relay how the object has translated, rotated and possibly how it scaled.

Student Researcher:

Kelah McFarland

School:

Mississippi State University

Major:

MS Computer Science

Classification:

2nd Year Graduate Student

Mentor:

Dr. Reginald Cooper



This summer I worked on two projects: ATHENA Workforce Development Environment and the Port Protection Program (P3). The ATHENA WDE is an initiative to create a software-based environment that aims to provide materials for self-taught learning, resources for research and development, and a knowledge base for reference and continuity. I was responsible for creating use cases to understand specific requirements of ATHENA and beginning the development of a mobile app for the podcast component in ATHENA. The Port Protection Program is a cybersecurity suite that monitors computer usb ports and allows administrators to control which removable devices can be used on computer systems. I was responsible for creating a website that will streamline the process that users use to request the software. Also, I was able to attend the AFWERX Fusion Conference in Las Vegas, NV after the Port Protection Program was selected from the AFWERX Fusion Challenge. During the conference, I was able to brief the Director of Defensewerx and other high-level Air Force leaders on the P3 software. I love this program. Every summer that I have been here, I've enjoyed the work that I have done and the people that I have worked with. Dr. Cooper really tries to find us work in our area of interest, and help us find an area of interest if we do not have one. UTC does a great job at making sure we are taken care of, and Mrs. Brown has made it very easy for us to reach out to her for help. I hope the program continues.

Student Researcher:

DeVante Moore

School:

Mississippi State University

Major:

Computer Engineering

Classification:

1st Year Graduate Student

Mentor:

Dr. Reginald Cooper

I ran 10 replications on path planning algorithms (4 planning & 5 replanning) for a different number of UAVs in a swarm (4) for each map of edges (2) recording the running time and cpu time. So in total about 720 simulation runs. The data were then used to be presented in bar charts that reflected running time and cpu times and their respective variances for each setting. The bar charts were then used for my presentation on Accommodating Plan Revisions with Multiple Agents for Local Search in Road Networks in preparation for the National Aerospace and Electronics Conference (NAECON). Thankful for having the opportunity to intern with this company again.



Student Researcher:

Christine Nguyen

School:

Rice University

Major:

**Materials Science and
Nano-Engineering**

Classification:

1st Year Doctoral Student

Area of Research:

**Laser Processing of 2D Materials for
Flexible Electronics**

Mentors:

Dr. Ajit Roy and Dr. Nick Glavin

This summer I worked on studying the laser irradiation effects of 2D transition metal dichalcogenide, Janus SMOSe. The purpose of this project is to induce local defects via laser processing to tailor structures of electronic components for Air Force electronic applications. By varying the laser and environment conditions, we can manipulate the atomic structure of the material and its properties to tailor it to a desired application, such as

(Continued on Page 9)



*(Minority Leaders Research Collaboration Program
2018 Summer Interns continued)*

flexible electronics, single-layer devices, and sensors. Raman spectroscopy was performed to characterize the material before and after laser irradiation. SEM was utilized to obtain images of the Janus SMOSe flakes before and after laser irradiation. TEM-EELS was used to obtain elemental composition mapping of the material.

Student Researcher:

Cristian Orozco

School:

**University of Texas at
El Paso**

Major:

Mechanical Engineering

Classification:

2nd Year Graduate Student

Area of Research:

Thin Film Fabrication and Characterization

Mentors:

Dr. John Jones

My summer research project was based on creating nonlinear optical metamaterials using multi-layer thin film coatings for second order optical response. These metamaterials with nanoscale dimension can alter the wavelength of photons as they pass through. Our goal was to create films that would be second harmonic generators. These metamaterial coatings can change the wavelength of light and have benefits such as easier infrared radiation (IR) detection and processing than with conventional materials. The films are able to be grown to the nanometer precision and were created using pulsed laser deposition (PLD), a method I learned last summer, and magnetron sputtering. I implemented the different characterization methods I used last summer to grow samples, such as X-Ray photoelectron spectroscopy, X-Ray reflectivity, ellipsometry and learned new methods such as transmission electron microscopy.



Student Researcher:

Lucas Raimondi

School:

University of Dayton

Major:

Chemical Engineering

Classification: Sophomore

Area of Research:

Thin Semiconductors

Created Through Pulsed Laser Deposition (PLD)

Mentor:

Dr. Shane Pacley

This summer I assisted Dr. Shane Pacley in her growth and study of β -Ga₂O₃ for wide band gap electronics. In particular, we analyzed the growth of β -Ga₂O₃ on various substrates. Pulsed laser deposition consists of the use of a laser, which ablates a target (e.g., a β -Ga₂O₃ target) in an argon atmosphere, creating a plasma plume of the ablated material that is deposited onto the substrate. The substrate is heated to a specified temperature enabling uniform absorption of the material. The samples each had varying growth conditions such as different substrate temperatures, different laser beam intensities, and varying number of laser pulses. This created a large number of samples that could be used in order to find the best growth method for β -Ga₂O₃ for the various substrates. We then analyzed the crystallinity of the substance using x-ray diffraction (XRD) to determine if the substance could properly form in thin layers.



Student Researcher:

Shannon Stevens

School:

Tuskegee University

Major:

Mechanical Engineering

Classification:

4th Year Undergrad Student

Area of Research:

Nanocomposite Research

Mentor:

Dr. Dhriti Nepal

My project focused on the influence of substrate effect and temperature effect on cellulose nanocrystals



(Continued on Page 10)

*(Minority Leaders Research Collaboration Program
2018 Summer Students continued)*

(CNCs). CNCs are rod-like particles that contain crystalline and amorphous regions. The crystalline components consist of cellulose chain segments in nearly perfect crystalline structures. The motivation behind this study is meant for next generation composites that are optically active and mechanically robust. Using polarized optical microscopy and scanning electron microscopy, I was able to examine light reflection and CNC pitch.

Student Researcher:

Ian Tallerine

School:

Texas A&M University

Major:

Aerospace Engineering

Classification: 5th Year Senior

Area of Research:

Polymer/Carbon Nanostructures

Mentor:

Dr. Josh Kennedy

My research this summer was based on characterization of surface activated carbon nanofibers. Fiber mats were prepared via electrospinning a solution of PAN and PMMA polymers in DMF. These fiber mats were hot drawn, thermally stabilized, and carbonized. Depending on the batch, some fibers were surface activated before carbonization, and some were nitrogen doped. Most of the characterization involved gas adsorption analysis. Nitrogen adsorption was used to find surface area and pore size distribution. Surface area and pore sizing calculations were checked with Matlab. To compare with the adsorption results, SEM imaging was performed on the fibers. Pore size distributions on the surface of the fibers as well as the internal structure were taken. Image processing was done using Wolfram Mathematica and ImageJ.



Student Researcher:

Shavon Turner

School:

Grambling State University

Major:

Computer Science

Classification: Junior

Area of Research:

Deep Learning, Machine Learning and Python

Mentors:

Dr. Kenneth Hopkinson

I familiarized myself with python and was able to complete the Deep Learning course that was provided for the interns to use as reference. I worked with another intern, Ross Wise, on the assignment given to us to complete. We were assigned the task of using neural networks to train a computer to find the coordinates of images at different angles and rotation. This internship was a good experience as I've learned from graduate students, interns, and supervisors about the tasks at hand. This internship has given me direction to the career path I will venture on to after I receive my undergraduate degree.



Student Researcher:

Khameron Wilcox

School:

University of Dayton

Major:

Chemical Engineering

Classification: Senior

Mentor:

Dr. James Blackshire

For this summer, my research was focused on quantitative analysis of backscatter energy fields on a dual-crystalline metal. Using non-destructive evaluation (NDE) techniques, I was able to generate images of the energy fields interacting with the grains in the nickel material. With these images, I was able to track the lobes in the energy field and plot the velocity of these lobes at different time intervals. Being able to track these lobes and analyze the energy field using NDE will ultimately help accurately determine the life span of the jet engine disks as well as other aerospace components with similar microstructure.



(Reflections continued)

Daniel Drake is an aerospace engineering doctoral student at Mississippi State University and has worked with the AFRL ML RCP for two years. Daniel, in cooperation with the Aerospace Systems Directorate, led by Dr. Steve Clay and the Materials and Manufacturing Directorate, led by the late Dr. Katie Thorp and Dr. Jonathan Spowart, investigated cure parameters on the development of residual strain during cure using embedded optical fibers. With the guidance of Dr. Rani Sullivan and other research team members from AFRL, the Boeing Co. and NASA Langley, Daniel has developed a methodology to estimate the internal propagation of delaminations within composites using optical fibers. Daniel is continuing this research for stitched sandwich composites in continuation with AFRL.

Dr. Rani Warsi Sullivan

Professor

Richard H. Johnson Chair

Department of Aerospace Engineering
Mississippi State University

ML-RCP provided an excellent opportunity to bring a bright undergraduate student, Shannon Stephens from Tuskegee University to work in AFRL. In the beginning, as a mechanical engineering major, she was enthusiastic about the mechanical characterization of the materials but had the least interest in chemistry and materials science. At AFRL, Shannon learned about biomimetic multifunctional materials. She fell in love with the topic and started exploring it with a great passion. As a result, Shannon was successful in making thin films of cellulose nanocrystals composite cholesteric liquid crystal and studied optical and mechanical properties. She made an outstanding impression among seniors in a short time, which was noted during her presentation in RX summer poster session. She is highly interested in going to graduate school in Materials Science and Engineering.

Dr. Dhriti NepalMaterials and Manufacturing
Directorate, AFRL

It is always encouraging and gratifying to see the enthusiasm and energy that students bring to the projects and their desire to explore the unknown with "outside the box" creativity. I truly enjoy the involvement in the ML-RCP as mentor and technical lead primarily because I see students advance and sometimes get job offers from major companies with all the networking they can accomplish during the program or when students express interest in working for the Air Force in the future. Many of the students end up collaborating with AFRL at some stage later in their career. This program is very important to give everybody a chance to pursue a career

in science and technology and to ensure strong future workforce for the ever advancing technology demands that the Air Force faces.

Dr. Hilmar KoernerMaterials and Manufacturing
Directorate, AFRL

The Research Collaboration Program has been a great experience! I have enjoyed my time working with researchers from Central State University. Exposing students to research and hands-on experience in science and engineering fields is important for our society as a whole.

Dr. Joseph Meola

Sensors Directorate, AFRL

As an Air Force POC for Cyber Security & Networking projects, the Minority Leaders Research Collaboration Program (ML RCP) has given me access to a number of innovative and valued-added technical projects. I've had the distinct pleasure of working with a number of talented principal investigators/professors and an even larger number of talented students from different colleges and universities. Some of those students that I've guided and mentored as interns have represented some of the highest caliber of undergraduate engineering and computer science students that I've ever encountered. I look forward to an opportunity to work with the ML RCP again in the future!

Mr. Rob Riley

Information Directorate, AFRL

I have had the honor and pleasure of participating in the ML RCP almost from its beginning as the Minority Leaders Program (MLP) in 2005. Over those 14 years, the program has been a shining example of what can be accomplished collaboratively by a team composed of dedicated faculty from a wide range of universities, a diverse array of focused student researchers from these universities, spanning undergraduate through PhD candidate rank, and motivated and caring expert AFRL scientists, engineers and program managers. Quality research of high value to the Air Force was accomplished, and professional relationships and friendships that will last a lifetime were established. Most importantly, students gained experience that will enhance their capability and confidence as they enter the STEM workforce and become the technology innovators of tomorrow. Accolades to all for a job well done!

Mr. Bob DenisonProgram Manager
Universal Technolocay Corporation*(Continued on Page 12)*

CURRENT ML RCP PARTICIPANTS



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(Reflections continued)

It has been an exhilarating experience to be part of the MLP / ML RCP since its inception in 2005. Over the years I had the opportunity and privilege to impart knowledge and work with a number of faculty and students. Together we did great research, published papers, and produced future researchers and leaders. But the most satisfying aspect of this program is building everlasting partnership and friendship.

Dr. Vasu Chakravarthy
 Sensors Directorate, AFRL

FAREWELL - Ms. DeANNA BROWN

Ms. DeAnna Brown, Universal Technology Corporation (UTC), who many of you have known through the years, departed UTC in August 2018. DeAnna left to join the Central State University (Wilberforce OH) team to serve as their Administrative Coordinator for the Undergraduate Student Success Center. One of DeAnna's favorite parts of working the ML RCP, was the opportunity to work with the students. She felt her new position would be the perfect job to allow more time with students. We will greatly miss DeAnna and want to extend our sincere appreciation for her many contributions to the program during the 11 years she was with UTC.

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