

2017 RET Summary

Participants

During the summer of 2017 two teachers participated in the RET. Kesandra Farmer was a science teacher at Andrews High School and a repeat participant. Christopher Washington, a repeat participant, came to the RET from James Benson Dudley High School. The following tables highlight the program participants.

Gender:

<u>Male</u>	<u>Female</u>
50%	50%

Racial Distribution:

<u>African-American</u>	<u>Asian-American</u>	<u>Caucasian-American</u>
100%	0%	0%

Program Staff

Many NSF ERC RMB personnel contributed to the success of the 2017 Research Experiences for Teachers. Some key individuals are listed below:

Jagannathan Sankar	Executive Director
Devdas Pai	Director for Education and Outreach
Lois Deve	Administrative Director
Robin Liles	Associate Director for Education Assessment
Vernal Alford	Coordinator, Young Scholars and Research Experiences for Teachers
Victoriya Yefimova	Budget Assistant
Dhananjay Kumar	Faculty Research Mentor
Svitlana Fiatkova	Faculty Research Mentor

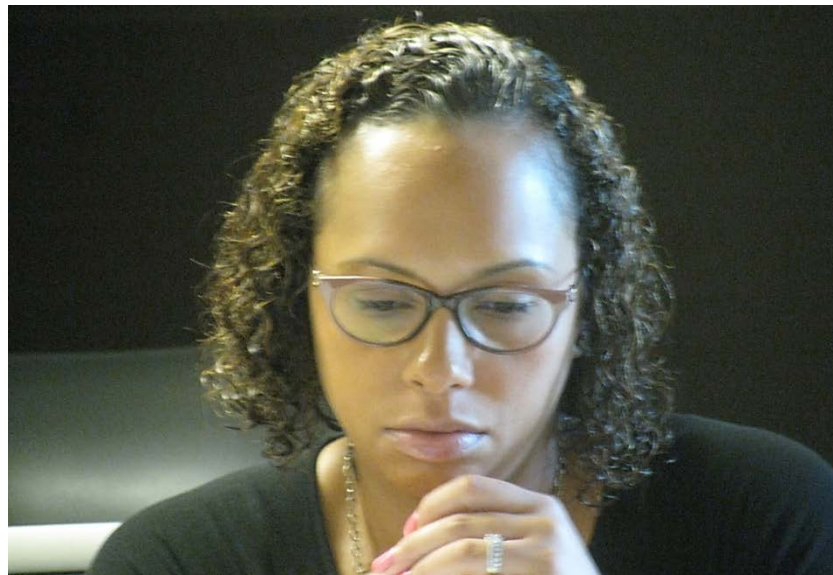
BRITE Center/Module Development

Participants engaged in a teachers-only field trip to the BRITE Center at North Carolina Central University during the fifth week of the program. The RETs were joined by other teachers from across the state. The participants were presented with a case study and spent the afternoon in nicely equipped laboratories to perform “testing” on certain samples. The BRITE Center is directed by Bettye Brown. Faith Freeman, former educational consultant for Module Development in the ERC, was instrumental in facilitating the workshop. To the coordinator’s surprise, two former RETs, Eric Craven and Cindy Nelson were also present at the BRITE Center.

There were no formal Module Development sessions in 2017. On their own, the RETs spent time adapting their research for use in their classroom settings. The RETs did present their modules to the two Young Scholars who provided their critiques.



The RETs went to the BRITE Center on the campus of North Carolina Central University.



Faith Freeman, former education consultant for the ERC, met the RETs at the BRITE Center.



Ms. Farmer works in the laboratory at the BRITE Center on the campus of North Carolina Central University.



Kesandra Farmer RET (left) shows Naya Henry YS and Olga Fialkova YS a demonstration of her module.



Olga Fialkova YS uses the apparatus designed and built by Christopher Washington RET to demonstrate impact.



Kesandra Farmer (left) and Christopher Washington are working on research in IRC 328. Joint Program

The Orientation was a day long exercise to get participants acclimated and prepared for the program. During the joint RET-Young Scholars Opening Program, many of the individuals with whom the RETs would make contact were introduced. All necessary forms were verified as completed and submitted to ERC personnel. The program provided training on documentation, including laboratory notebooks and intellectual property. During the afternoon, the participants underwent Safety Training led by the campus Safety Office. Because of campus policy, that all campus program participants must carry appropriate identification, the RETs were subsequently photographed and received their Aggie One cards. In conjunction with the Young Scholars program, library staff conducted a seminar on researching scholarly articles.

Two workshops were presented during the program. The first was facilitated by Ms. Donna Eaton, Division of Research, and entitled “Responsible Conduct in Research.” The second workshop, “Presentation Techniques”, was delivered by Dr. Tonya Hargett, Division of Research.

Various seminars were held throughout the program. The center’s Director for Education and Outreach gave an overview of the ERC. Dr. Robin Liles entitled her seminar “Bioethics.” Matthew McCullough’s seminar topic was “Computational Biomechanics”; Dr. Laura Collins presented on “Intellectual Property.” Dr. Zhigang Xu facilitated a seminar based on his research. The RETs and Young Scholars presented their six-week research experience to the other programs’ participants during the last seminar. Journal Club meetings were held on Friday afternoons.



Dr. Kumar (left) led the Journal Club.

Program Feedback and Continuous Improvement

Briefing sessions were held every week for the RETs. These were held to elicit feedback from the participants and the coordinator. During these times, the teachers submitted their weekly journals both orally and electronically. The Coordinator would review the upcoming schedule, particularly any changes, so that any confusion might be quelled. Instructions would be given on preparing newsletters, journals, posters and final oral presentations. The group would also go through the topics covered in the Technical Testing to prepare individuals for the post-testing. Additionally, the Coordinator would use that time to encourage the participants.

Posters

The Poster Defense was held on Wednesday, July 26, 2017. The research teams were grouped aligning with faculty mentors.

Field Trips

Field trips were to The Nussbaum Center for Entrepreneurship, Greensboro and the Joint School of Nanoscience and Nanoengineering located at Gateway Research Park South, Greensboro. The joint program participants were conveyed by vans to the joint department of Biomedical Engineering at North Carolina State University and the University of North Carolina in Raleigh and Chapel Hill, respectively.



(above) Vice-President Clay Howard (right) introduces the Nussbaum Center to the ERC summer researchers.



The summer researchers are shown at Joint School of Nanoscience and Nanoengineering.



**Joint Department of Biomedical Engineering,
UNC Chapel Hill and NC State University**

Individual experiences

Kesandra Farmer

Kesandra Farmer has been teaching Science at T. Wingate Andrews High. She has taught multiple Science courses, as well as Health and Physical Education, with her most enjoyable course being Physical Science. She received both her BS degree in Human Nutrition, Foods and Exercise – Science Option and MSEd degree in Health Promotion and Wellness from Virginia Tech. Kesandra has a 4 year old son, Reign, who is also a lover of Science and enjoys building structures using Magnetix. When she is not researching, Kesandra enjoys spending time with family and friends, travelling, event planning and visiting gourmet cupcake shops. She aspires to be a public school assistant principal via the NC Principal Fellows program.

This summer, Kesandra Farmer worked in Dr. Kumar's lab alongside graduate students Surabhi Shaji and Nikhil Mucha, focusing on thin films and the pulsed laser deposition (PLD) process. The objective of her research was to study the physical properties of titanium nitride when deposited by pulsed laser deposition under specific conditions. The variables for this study were temperature, pressure and presence of nitrogen ambient. These are used in relationship to previous literature in order to determine the best parameters for optimal coating conditions. Pulsed laser deposition is a technique in which a high powered laser strikes and vaporizes a target material to be deposited onto a substrate.

Kesandra's module, entitled "We've Got You Covered," compares common coating materials to TiN thin films.

MSU-ERIC Center for Reconstructing Materials
Structural and Physical Properties of Pulsed Laser Deposited Titanium Nitride Thin Films
Kesandra Farmer, Nikhil Mucha and Surabhi Shaji

Introduction
The thin film layers were used in thin film fabrication since it was first used by H.M. Maer and A.F. Carter. The PLD technique using pulsed laser (PLD) was used to fabricate high temperature superconducting thin films. The objective of this study was to study the physical properties of titanium nitride when deposited by pulsed laser deposition under specific conditions.

Objectives
The objectives of this study were to synthesize high quality TiN thin films and study the structural and physical properties of TiN thin films.

Materials and Methods
The fabrication of Titanium Nitride thin films on Sapphire substrates was done by Pulsed Laser Deposition. For this purpose, a high vacuum of about 10⁻⁷ torr, an argon laser (1000 mW) with 100 ns pulse duration (wavelength 248 nm, pulse duration 10 ns) was used. The laser is electrically discharge with a voltage between 15 kV to 20 kV is applied.

Pulsed laser deposition (PLD)
PLD is a conceptually and experimentally simple and versatile tool for depositing thin films of a wide range of materials, on a wide range of substrates, even at room temperature. Using the PLD technique, TiN was deposited on sapphire substrates. A pulsed KrF excimer laser (100 ns pulse duration, wavelength of 248 nm, laser energy of 300 mJ) was focused into a rotating TiN target at a vacuum. The material evaporated, creating the laser plasma, and deposited on the substrate, forming the thin film. This was done at the varying pressure (20 mTorr, 200 mTorr) with an other parameters kept constant.

PLD Advantages
• High deposition rate
• Broad material palette
• Reaction diversity

Characterization Techniques
• Scanning Electron microscopy (SEM)
• X-ray diffraction and Reflection (XRD & XRF)
• Energy-dispersive X-ray Spectroscopy (EDS)
• Atomic Force Microscopy (AFM)

Results
Thin growth measurements
The deposition rate or the film growth measurements of thin film deposited on sapphire was measured using atomic surface profile.

Target	Power	Thickness	Rate	Pressure	Temperature
Titanium	15,000	120 nm	0.0084 nm/pulse	0.77 Torr	1000 C

SEM analysis
The deposition rate or the film growth measurements of thin film deposited on sapphire was measured using atomic surface profile.

EDS Analysis

Element	Weight %	Atomic %
Ti	51.2	51.2
N	48.8	48.8

SEM analysis
The deposition rate or the film growth measurements of thin film deposited on sapphire was measured using atomic surface profile.

AFM analysis
The deposition rate or the film growth measurements of thin film deposited on sapphire was measured using atomic surface profile.

Conclusion
• Successfully fabricated sapphire coated TiN thin films
• The structural and physical properties of TiN thin under different conditions are analyzed
• Effect of nitrogen during thin film deposition is studied

Acknowledgements
We would like to acknowledge and thank Dr. Kumar for his support, guidance and assistance during this study. Also to the MSU-ERIC and the center MSU-ERIC.

Christopher Washington

Mr. Washington graduated from the University of South Carolina in 1996 with a BS in Biology. After three years of searching he began his teaching career in Raleigh North Carolina at Daniels Middle School and spent the next year at Zebulon GT Magnet Middle School. Thus ended his journey in Middle schools; he then moved to Connecticut, where he spent the next five years teaching high school students at Brien McMahon High School in Norwalk. He taught Chemistry, Physical Science, Astronomy, and a Forensics program that he helped develop. In 2006 he moved Greensboro NC and began teaching at the James Benson Dudley High School. He has taught Physical Science, Earth Environmental, Biology, Chemistry and AP Environmental Science. Mr. Washington also taught at Twilight High School for 6 years. He is married and has two children. In his spare time he enjoys hunting, fishing, and inventing.

During the summer, Chris Washington was working in the lab with Dr. Svitlana Fialkova and undergraduate student, Hadiyah Jones researching the “Effect of Zn Content on Hardness of Mg Alloys.” His research primarily focused on looking at the effects of the varying amounts of Zinc present in Magnesium-Zinc alloys and how varying amounts of zinc affected grain structure (size), chemical and mechanical properties of various samples of known zinc content.

