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Newsletter 2015

NSF ERC-REVOLUTIONIZING METALLIC BIOMATERIALS
STUDENT ASSOCIATION

From the desk of Director Sankar

Welcome to the sixth student-generated newsletter of the Engineering Research Center for Revolutionizing Metallic Biomaterials (ERC-RMB). Our Gen 3 ERC's mission is to transform current medical and surgical treatments by creating "smart" implants to improve treatments for orthopedic, craniofacial and cardiovascular ailments coupled with the development of a vibrant, diverse workforce well-prepared for the multidisciplinary and global challenges and opportunities of the new millennium.

Our Student Leadership Council (SLC) and student members continue to excel on many fronts as they rally behind the Center philosophy "One Team, One Dream." This SLC report highlights the Center's outstanding accomplishments on multiple fronts. We are truly excited about the intellectual growth and leadership of these ERC students - our next-generation innovators and thinkers.

Our enhanced approach to industrial engagement, in the form of revisions to the Membership Agreement made in 2013-2014, have started to pay dividends. Strong synergistic interactions are taking place with our industry members, ranging from science to translational opportunities. In particular, our knowledge in processing and development

of various Mg degradable alloy systems, coating technologies, corrosion science, and our testing and characterization methodologies are attracting great interest from industry, leading to new partnership initiatives. In Year 7, our ERC continued to engage with industry and the global community through our routine Friday webinar series and through the AC 87 committee that rose out of the ASTM-ISO groups to develop biodegradable metals testing standards.

Once again, advances in ERC-RMB science have been matched by milestones in education and outreach. In Year 7, with two undergraduate cohorts graduated, the NC A&T Bioengineering faculty are prepared for their inaugural ABET accreditation visit in Fall 2015.

ERC students and staff have garnered national and international recognition and citations. Their accomplishments and leadership achievements are proudly documented here and on our website, <http://erc.ncat.edu>.

On behalf of the entire ERC team, I'd also like to take this opportunity to extend special appreciation to our Educational, Clinical and Scientific, and Industrial Advisory Board (EAB, CSAB, and IAB) members for their incredible dedication and time.



Again, welcome to our Center. I look forward to your feedback and participation as we continuously strive to improve.

Sincerely,

Jag Sankar

sankar@ncat.edu

ERC-RMB Center Director

Welcome to the 2014-2015 issue of the student-generated ERC-RMB newsletter. Our center continued to expand the level of scientific research being conducted on our campuses while simultaneously creating a positive impact on our communities. The Student Leadership Council (SLC) is pleased to report our past year's exceptional progress we have made including research activities, educational and outreach efforts, and student accomplishments.

Featured articles include updates on student

travel and knowledge gained from both national and international conferences. The SLC was also able to host a mock FDA pre-submission panel review as part of our Student Retreat in order to increase awareness of the FDA medical device regulatory pathway. Graduated students have been able to successfully transition into careers in industry and higher education as showcased through the alumni highlights. This year there was significant advancement made in student research as seen in the abundance

of papers we published, with selected work showcased here. The talent in our dynamic center was put on display in a number of recognitions and strong showings in competitions on both research and entrepreneurship.

As always, we greatly appreciate and commend the effort put forth by our newsletter team, editors Da-Tren Chou and Jingyao Wu, as well as the continued support and excellent guidance from the ERC leadership team.

SLC Co-Presidents:

Paul McGhee

North Carolina A&T (NC A&T)

Yonghai Zhang

University of Cincinnati (UC)

Da-Tren Chou

University of Pittsburgh (Pitt)

Dr. Sankar giving an inspiring introduction to kick off the Student Retreat.



Events and Activities

Students Convene for Annual Retreat and FDA Mock-Panel

On April 17-18, 2015, ERC-RMB students attended our annual Student Retreat, this time hosted at NC A&T. The two-day meeting was kicked-off with an impassioned introduction by Center Director, Dr. Sankar where he inspired the students in attendance to innovate not just in our current research in biodegradable metals but in every facet of life. The main event of the retreat was the first-ever FDA Mock Panel event, organized by the SLC Co-Presidents along with Industrial Liaison Officer Dr. Peter Seane and Senior Project Manager Richard Hoff. The goal of the FDA Mock Panel was to generate discussion and feedback for our center's research in the context of an FDA pre-submission for a degradable magnesium bone fixation screw. Pre-submissions are a critical step in the pathway for medical device market approval to understand what gaps in testing and device understanding need to be filled prior to premarket submission to the FDA. Students had the privilege to engage four panelists with extensive experience in navigating the FDA regulatory

process:

- Jim Fentress, EG Gilero Director of Engineering
- Gregory Gatto, RTI Drug Development Regulatory Project Leader
- Patsy Trisler, JD, RAC, Trisler Consulting
- Cheryl Wagoner, Wagoner Consulting

Each panelist discussed their unique career paths and experiences in working with or within the FDA.

Prior to the session, students at all three universities prepared a document and presentation based on pre-submission guidelines for medical devices. Using a comprehensive search of FDA guidances, standards from the American Society for Testing and Materials (ASTM) and International Organization for Standardization (ISO), and information regarding past FDA approval of resorbable screws, the student team compiled test protocols and results on their materials, coatings, and devices as related to a fixation screw. Their work was presented during the

half-day long panel session in which the invited panelists provided insightful feedback and engaged students in continued discussions. The panelists even stayed during lunch and after the panel formally concluded to answer specific questions. The Mock Panel proved to be an extremely valuable learning tool for the students to get a feel for the regulatory

process and provided solid advice on additional evaluations to be performed on our resorbable devices, as well as on how to approach the FDA.

The retreat also included a seminar given by Carey W. Pahel, Au.D., CCC-A, Doctor of Audiology at the Pahel Audiology & Hearing Aid Center in Greensboro, entitled "Hearing Aids: Past, Present and Future" in which he discussed challenges that exist in helping the hearing impaired. This talk was especially relevant to the ERC-RMB students and researchers as Dr. Pahel introduced clinical challenges that currently exist in the field and the functional requirements that innovative hearing assistance devices of the future will need to satisfy.

Following research discussions and a seminar from NC A&T Senior Research Scientist Dr. Sergey Yarmolenko on "Functional Thin Film Coatings of Metallic Biomaterials", students from NC A&T took their visiting colleagues on an instructive tour through their various labs on campus. After a fruitful day of activities, everyone went out to a delicious barbeque dinner to unwind and further connect.

On the following day, the SLC addressed organizational issues including plans for each SLC committee, submitting information into the ERC-RMB Materials Database, and performed a SWOT analysis on the center. This iteration of the Student Retreat was another success, exposing students to medical device regulatory affairs while giving them a chance to discuss their research and foster new relationships while strengthening old ties.

- Da-Tren Chou (Pitt)



Avinash Patil (Pitt, left) and Paul McGhee (NC A&T) hear about the pulsed laser deposition setup during the afternoon lab tours.

ERC Welcomes Back Alumnus, Satish Singh for Professional Development Webinar

On March 26, 2015, the SLC welcomed back Dr. Satish Singh to present a professional development webinar on his career path from graduate school to industry with insight into how to prepare and succeed during job interviews. Dr. Singh graduated in July, 2014 from the University of Pittsburgh with a PhD in Chemical Engineering, while also having served as co-President of the SLC while a graduate student. Current students learned how Dr. Singh was able to secure his current position as Research Scientist at Avon, where he now scouts and evaluates new technologies while also interviewing potential new employees at the company. Thus, Satish was able to provide valuable advice to students from his personal experience in applying and interviewing for jobs himself, as well as

from his time being on the other side and interviewing candidates. His presentation detailed interviewing best practices from giving a technical presentation, to preparing for one-on-one interviews, to how to act after the interview has concluded. He wrapped up his seminar by sharing the mantra of his current workplace: "One Team One Avon", which echoed our ERC's motto: "One Team One Dream", demonstrating that organizations all must work together as a team in order to succeed. The ERC-RMB students in attendance all found value from Dr. Singh's talk and were happy to hear from their former colleague and catch up on his current career.

-Da-Tren Chou (Pitt)



ERC-RMB Interacts with other ERCs at the 2014 Biennial Meeting

Every other year, a meeting of ERC directors and other key staff, faculty, and students is held in the late fall in the Washington, DC area. This meeting provides a unique opportunity for interaction between the NSF and attendees from all the centers regarding programs, policies, progress, and plans. Four students from Pitt — Da-Tren Chou, Katie Farraro, George Hung and Jingyao Wu, along with a number of faculty and staff attended the ERC biennial meeting on Oct. 27-28th, 2014 representing the ERC-RMB.

The theme of the 2014 meeting was *Building Tomorrow's Leaders*. Speakers hailing from ERCs as well as outside institutions representing various fields provided their insights on how to educate graduate student while training the next generation of leaders in STEM. Dr. Debasish Dutta, Provost of Purdue University, described the

effect of the ERC program on her school and how Purdue's education and research fronts benefited from multiple engineering research centers funded within the campus over the past decades. In the Graduate Education Panel Session, three speakers gave their perspectives. Dr. Janet Rutledge from University of Maryland, Baltimore County, discussed how universities could provide an innovative culture and environment to help students. Two ERC alumni, Dr. Eric Jayjock and Dr. Michael McCorquodale, then shared their career experiences and how their ERC experience helped with their career development. The Perfect Pitch Competition was held later in the afternoon after a poster session on each ERC's educational programs. Katie Farraro gave a pitch on LigaMend, doing the ERC-RMB proud by winning third place (described further on page 7). During the

meeting, NSF Program Director Dr. Deborah Jackson also shared the news that Satish Singh and Portia Taylor, previous SLC presidents of the ERC-RMB and ERC-QoLT were recently engaged!

The next day started with a brief introduction of all currently funded engineering research centers by Dr. Keith Roper. During the breakout sessions, the ERC-RMB teamed up with other biotech and healthcare related centers to discuss how to promote graduate level education and the translation of biotechnologies. Representatives from each breakout session summarized their discussions after lunch. The afternoon session provided talks on funding opportunities from different agencies, such as Department of Energy, Environmental Protection Agency, FDA and NIH. Finally, the ERC-RMB SLC members joined a two-hour session with SLCs from other ERCs, where they discussed best practices from their experiences, and enjoyed a riveting talk on Communicating Science by Renée Hlozek, a South African cosmologist, Rhodes scholar and Senior TED Fellow.

- Jingyao Wu (Pitt)



The announcement of the engagement of two former ERC SLC presidents, Satish Singh and Portia Taylor.



Katie Farraro with her Perfect Pitch award with ERC-RMB's Dr. Seone, Dr. Pai, and Dr. Sankar.



A closer look at projects within the ERC-RMB

Research Highlights

Pitt Study Shows the Promotion of Bone Healing from Magnesium Plates and Screws

Researchers from the University of Pittsburgh recently published two manuscripts describing their work developing and testing magnesium (Mg) plates and screws for bone fracture fixation. The preliminary manuscript, titled "Fracture healing using degradable magnesium fixation plates and screws" (Chaya et al., J Oral Maxillofac Surg. 2015) describes a pilot study in which Mg devices were compared to clinically-used titanium (Ti) devices to stabilize rabbit ulna fractures. Results showed no inhibition of fracture healing in the presence of Mg degradation. Furthermore, new bone overgrowth was observed around Mg, but not Ti, devices. These results demonstrated preliminary efficacy of Mg devices in a semi-load bearing fracture model, and were further validated by a follow-up study.

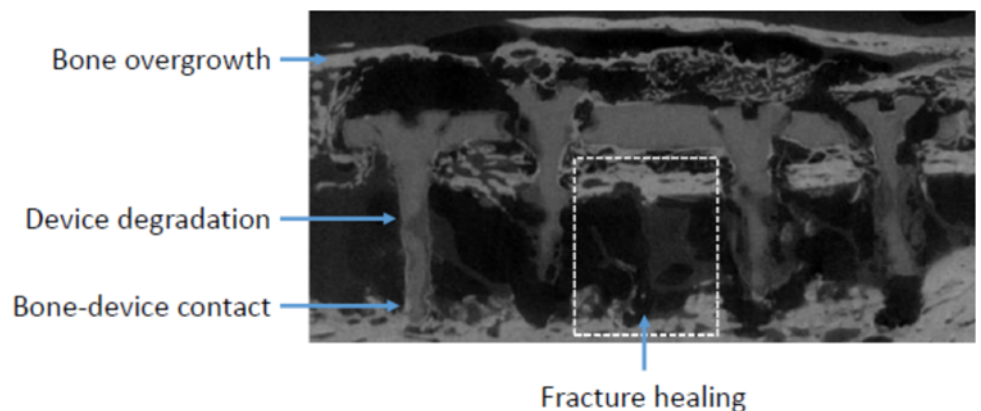
The follow up study, titled "In vivo study of magnesium plate and screw degradation and bone fracture healing" (Chaya et al., Acta Biomater 2015) highlighted complete

fracture healing and bone remodeling for fractures stabilized with Mg devices. Furthermore, progressive bone overgrowth was observed.

These studies demonstrate the potential for Mg to serve as an ideal material for bone

fixation devices by facilitating healing and enhancing local bone growth. Additional work is currently being conducted to better understand the effects of Mg degradation rate on bone formation.

- Amy Chaya (Pitt)



MicroCT imaging showing fracture healing and bone formation over the MG plate and screws

NC A&T Researchers Decipher the Effect of Magnesium Degradation Products

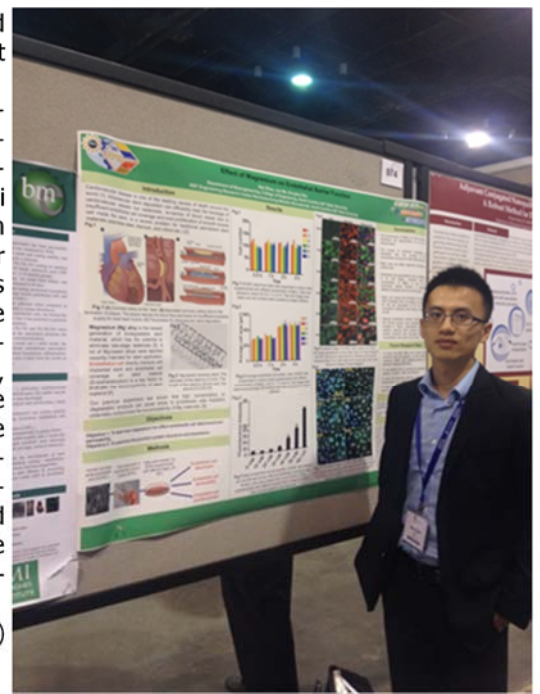
Vascular stents are one of the major applications of magnesium-based alloys. Studying the effects of degradation products from magnesium stent materials on blood vessel cells is of great importance to evaluate the potential of magnesium materials.

The paper entitled "Endothelial responses of magnesium and other alloying elements in magnesium-based stent materials" was published in *Metallomics* by Nan Zhao and Dr. Donghui Zhu. This work studied the *in vitro* biological effects of magnesium ions on vascular endothelial cells. It is the first study which reports the effects of magnesium on endothelial cell viability, proliferation, migration, cell skeletal structure, and gene expression. The study determined the half-maximal effective concentrations for different alloying elements. It was also found that low concentrations of magnesium ions could serve as beneficial factors for endothelialization. Findings from this work provide useful information on maximum safe doses of these ions for endothelial cells, endothelial

responses towards these metal ions, and guidance for future magnesium stent design.

In another paper entitled "Collagen self-assembly on orthopedic magnesium biomaterials and subsequent bone cell attachment", Nan Zhao and Dr. Donghui Zhu studied the interaction between magnesium materials and extracellular matrix protein from bone tissues. It was shown that the final collagen structure and bone cell attachment could be controlled by varying different parameters, such as pH of the solution and surface roughness of the materials, to mimic the native bone structures. Future work regarding how magnesium affects mineralization around collagen structures could lead to a better understanding of the interaction of bone tissues with the magnesium implant materials.

- Zhao Nan (NC A&T)



Nan Zhao presented his work at SFB 2015 in Charlotte, NC.

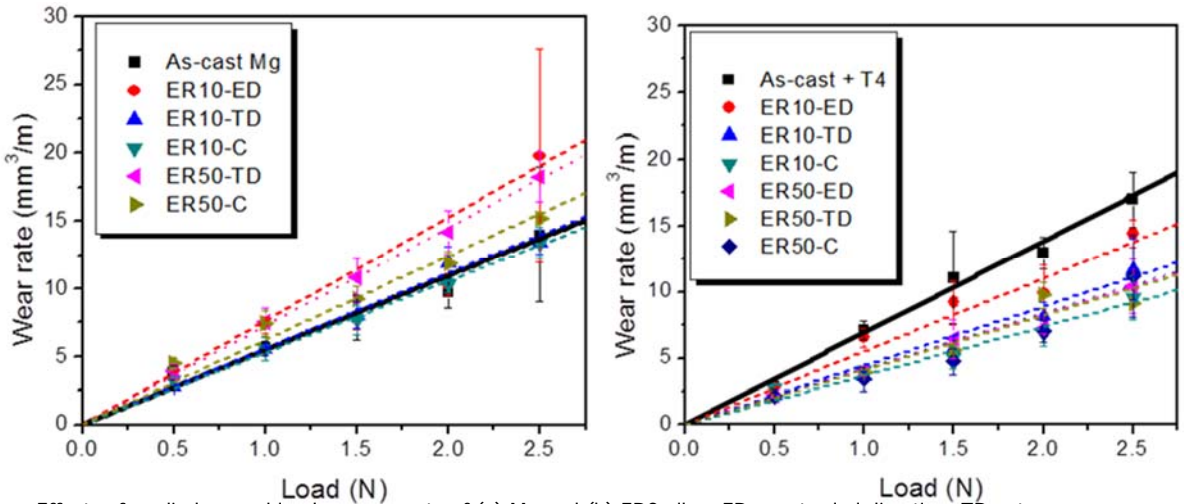
Study Raises the Question of Wear Resistance of Magnesium Alloys Post-Extrusion

The purpose of this study was to investigate the tribological characteristics on pure Mg and an ERC alloy under as-cast and extruded conditions. Extruded specimens were cut normal and parallel to their extrusion direction resulting in cross-sectional and longitudinal sections. Wear testing was conducted on both sections using a microtribometer with reciprocating configuration and a sapphire counterface. Specimens were subjected to applied normal loads of 0.5 – 2.5 N (increment of 0.5 N) for 120 cycles. The longitudinal section was subjected to directional wear tests, where wear was applied along the extrusion and transverse direction. The results showed a lower wear rate in the cross-

sectional plane and along the transverse direction of the longitudinal plane for both pure Mg and ERC alloy. Deformation processing was found to have dissimilar effects on the wear resistance on Mg and the ERC alloy. It was found that with the combination of alloying and extrusion, a

negative effect was produced on the wear behavior of Mg by decreasing its overall wear resistance while positively promoting the wear behavior of the ERC alloy with an increase in wear resistance and hardness.

-Paul Paul McGhee (NC A&T)



Effects of applied normal load on wear rate of (a) Mg and (b) ERC alloy. ED = extruded direction, TD = transverse direction, C = cross sectional section.

Flow-induced Corrosion Study Provides Insights on Magnesium Stent Degradation

Absorbable metals have been widely tested in various *in vitro* settings using cells to evaluate their possible suitability as an implant material. However, there exists a gap between *in vivo* and *in vitro* test results for absorbable materials. Many traditional *in vitro* assessments for permanent materials are not applicable to absorbable metallic implants. A key step is to identify and test the relevant microenvironments and parameters in test systems, which should be adapted according to the specific application. Since the ERC-RMB's inception, one of the basic science research objectives has been to effectively study, model, and optimize the degradation behavior of Mg stents. In terms of Mg stents, corrosion needs to be performed and characterized in hydrodynamic conditions found within vessel walls.

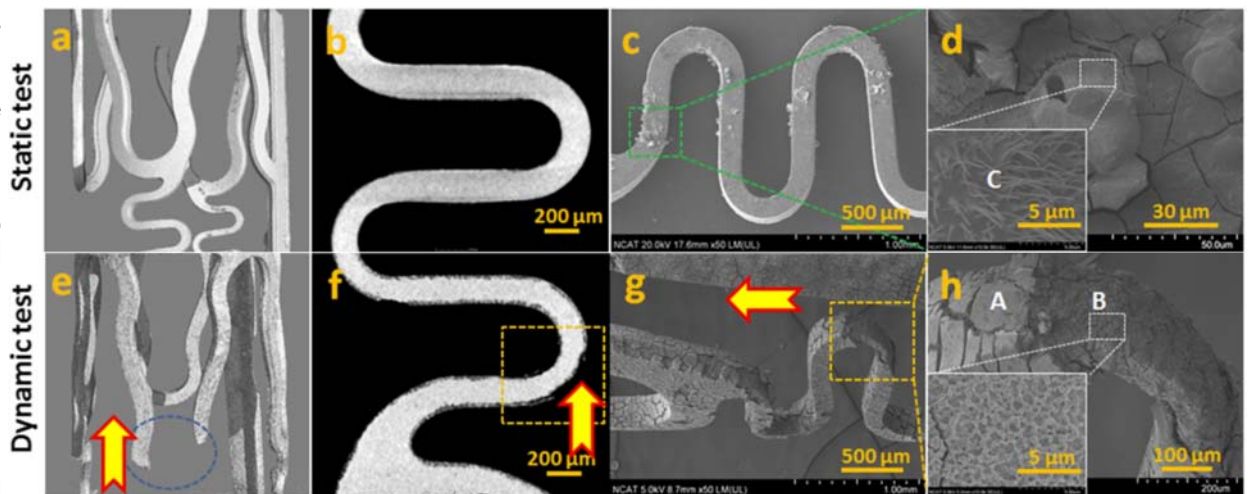
Biocorrosion Testing Thrust leader, Associate professor Yeohung Yun, and visiting Ph.D. stu-

dent researcher Juan Wang studied corrosion behavior of magnesium under varied fluid flow conditions representative of the vascular environment. Their work entitled "Flow-induced corrosion behavior of absorbable magnesium-based stents" was published in Acta Biomaterialia in September 2014. This work discussed the comprehensive and statistical study of the effects of fluid hydrodynamics, fluid flow velocity and shear stress on the corrosion of Mg stents.

In an effort to understand the impact of

vascular conditions on Mg alloy corrosion they measured corrosion types, corrosion rate, corrosion morphologies, composition and thickness of corrosion products, and hydrogen evolution of Mg alloys and stents as a function of flow-induced shear stress in a vascular bioreactor. By understanding the corrosion behavior of Mg alloys in flow conditions, this work provides knowledge for expanding clinical applications of Mg-based stents in multifarious implantation positions.

-Juan Wang (NC A&T)



This study showed that flow direction has a significant impact on corrosion behavior as more severe pitting and erosion corrosion was observed in dynamic test compared to static test.

AWARDS & RECOGNITION

Celebrating achievements of our Center's members!

Zanshé Thompson Excels in Research and as a Student Leader

Ms. Zanshé Thompson, who recently defended her Master's Thesis after working in the lab of Dr. Bhattarai at NC A&T, exemplified the drive and passion for success of the ERC-RMB with a number of achievements over the past year. As Regional Director of Outreach for the National Association of Graduate-Professional Students (NAGPS), Zanshé was one of about 50 graduate students from across the nation to participate in the NAGPS's Legislative Action Days. At the Legislative Action Days, Zanshé had the opportunity to meet with Congressman David Price (NC) and Congresswoman Carolyn McCarthy (NY) and their staff, receive advocacy training, and learn about the legislative process and issues affecting graduate education. As part of the meeting, Zanshé and other students approached these Representatives with a list of issues that affect graduate students and advocated for change in those areas. At the 2014 NAGPS National Conference she gave a TED-style talk entitled "Electrospinning for Neural Applications".



Zanshé accepting award her first place award at the Graduate Student Advisory Council poster competition at NC A&T.



Zanshé (third from right) with other students from NC A&T and Duke meeting with Congressman David Price (second from right).

Ms. Thompson also received a number of research accolades, including winning first place at the 2015 NC A&T Graduate Student Advisory Council poster competition (where fellow RMB student Adrienne Williams also won second place) and second place at the NC A&T 4th Annual College of Engineering graduate poster competition. She also received the Biomedical Engineering Society (BMES) Innovation and Career Development Award at the 2014 BMES annual meeting and won honorable mention for the 2015 NC A&T Golden Aggies Leadership Award. The ERC-RMB is proud of the impact that Zanshé has made in research and through her leadership and her example is one that we hope other students in the center will follow.

- Zanshé Thompson (NC A&T)

Magnesium Device and Student Entrepreneur Steal the Show at Events Across the Country

In addition to ERC-RMB's collection of novel Mg alloys and surface coatings and treatments, one of the center's greatest strengths is the concurrent development of new and innovative devices for a variety of biomedical applications. From plates and screws to nerve conduits to tracheal stents, the possibilities for revolutionizing medical treatments are real and exciting. In addition, these projects have given students the unique opportunity to participate in entrepreneurial competitions and other events.

The Mg Ring (or LigaMend) in particular has achieved entrepreneurial success. Ligamend is a device used for repair and regeneration of an injured anterior cruciate ligament (ACL) in the knee. It was developed in the Musculoskeletal Research Center at the University of Pittsburgh by doctoral student lead Katie Farraro, under the guidance of Dr. Savio L-Y. Woo, and features material and surface treatment collaborations with Dr.

Vesselin Shanov (UC) and Dr. Yeoheung Yun (NC A&T).

After winning first place in Pitt's Randall Family Big Idea Competition in April 2014, Katie and her MBA student partner, Danielle Martin, went on to win a regional entrepreneurship competition entitled, "Health 2.0: The Winner's Circle," featuring winners of several local competitions. Katie then went on to win third place in the Lynn Preston Perfect Pitch Competition at the ERC Biennial Meeting and Best Honorable Mention in the TERMIS-AM Business Plan Competition in December, 2014. She and the LigaMend team are now in the final round of competition for the Coulter Translational Partners II program at Pitt. Furthermore, the technology has also received great interest by Beijing Naton Technology Group, one the largest orthopedic implant companies in China.

LigaMend's entrepreneurial success has not only emphasized the ERC-RMB's excellent translational work, but has also highlighted the important skills and networking opportunities provided to its students. These enriching educational experiences have allowed ERC-RMB grads to be well-prepared for future careers in industry and academia.

- Katie Farraro (Pitt)



Katie (left) accepting her 3rd Place award at the Perfect Pitch competition with France A. Córdova, director of the NSF.



Pitt BioE Undergraduate Excels under ERC-RMB Mentorship

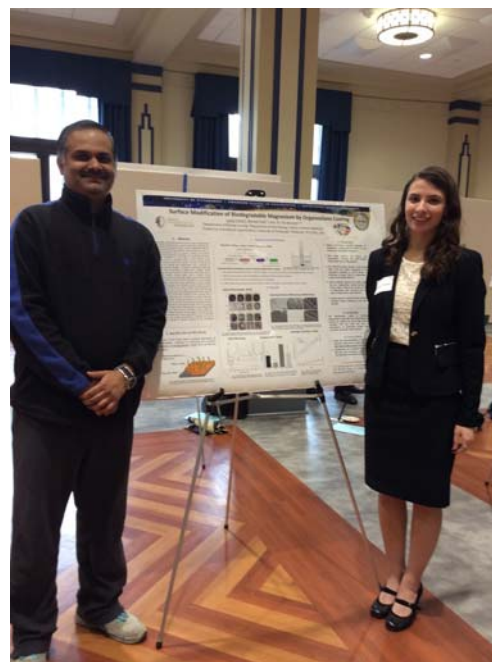
Since the fall of 2014, Avinash Patil, a PhD student in Dr. Elia Beniash's lab at the University of Pittsburgh, has been mentoring an undergraduate BioE Engineering student, Laura Fulton, with the two achieving great results. Avinash has supervised Laura as they have worked on the project titled "Effect of Organosilane Coating on Corrosion Rate of Biodegradable Magnesium and its Alloy AZ31". Their work is centered on the hypothesis that organosilane coating will control the corrosion rate of biodegradable metals and will further help to functionalize the surface with biological molecules. In their experimental setup, Laura and Avinash used different characterization techniques such as scanning electron microscopy, attenuated total reflectance-Fourier transform infrared spectroscopy, and contact angle measurement to study the quality of their coating. The results of their research supported their hypothesis that organosilane coating controls the corrosion rate of Mg and AZ31 (a common Mg alloy).

For this work, Laura and Avinash won third prize at the annual BioE Day poster competition organized by the Bioengineering Department at Pitt. They are planning to pre-

sent their results at the 7th Symposium on Biodegradable Metals in August, 2015.

With the experience gained working in Dr. Beniash's lab, Laura was among ten undergraduate students selected for the Research Experience for Undergraduates (REU) internship at the University of Pennsylvania. This summer she will conduct research as part of UPenn's Nano/Bio Interface Center. Laura will work in the lab of Dr. Marija Drndic on the project "Development of nanoscale structures for electronic transport and nano-electric applications." She will get hands on experience in wafer processing, chip fabrication, and optical and electron beam lithography. She hopes to apply the research knowledge gained at the Drndic lab back to the organosilane project when she will return to Pitt in the fall. There, her and Avinash's research will continue with patterning of the organosilane coating layer via lithography technique to vary the corrosion rate of organosilane coated magnesium. Laura is grateful for the research opportunities made available by Dr. Beniash and Avinash and the ERC-RMB for making her experience possible.

- Avinash Patil (Pitt)



Laura and Avinash during the poster session at Pitt's annual undergraduate research day.

Team from NC A&T and Middle School Teacher Win Third Prize at the Biomaterials Education Challenge at SFB 2015

Four graduate students from NC A&T (Nava P. Rijal, Zanshe Thompson, Shekh M. Rahman, and Udhav Adhikari), 6th grade school teacher Cindy Nelson, and advisors Drs. Naryan Bhattarai and Devdas Pai won third place and a \$500 prize at the "Biomaterials Education Challenge". The competition, part of the Society for Biomaterials (SFB) 2015 Annual Meeting (more on page 13), tasked groups of students around the country to develop innovative and practical approaches to biomaterials education. Students were challenged to develop hands-on educational modules for a middle school science class.

The ERC-RMB team's education module, **"Modeling of Biomaterials Research for Middle School Science Students: An Inexpensive and Fun Approach to Hands-on Biomaterials Education"** was designed to demonstrate fundamental biomaterials concepts suitable for a middle-school audience with hands-on and easily obtained resources.

The objective of this module was to engage middle school students by evolving the fields of tissue engineering and regenerative medicine. These experiments provided an exciting way to relate classroom instruction to real-world biomedical applications and were intended to spark interest in youth to pursue higher education and careers in STEM. The NC A&T team designed three simple experiments that relate to



Cindy Nelson (second from left) presenting the nerve conduit educational module to the judges. From left to right: Nava Rijal, Cindy Nelson, Zanshe Thompson, and Dr. Narayan Bhattarai.

state-of-the-art research in the manufacture of advanced polymeric biomaterials, described below:

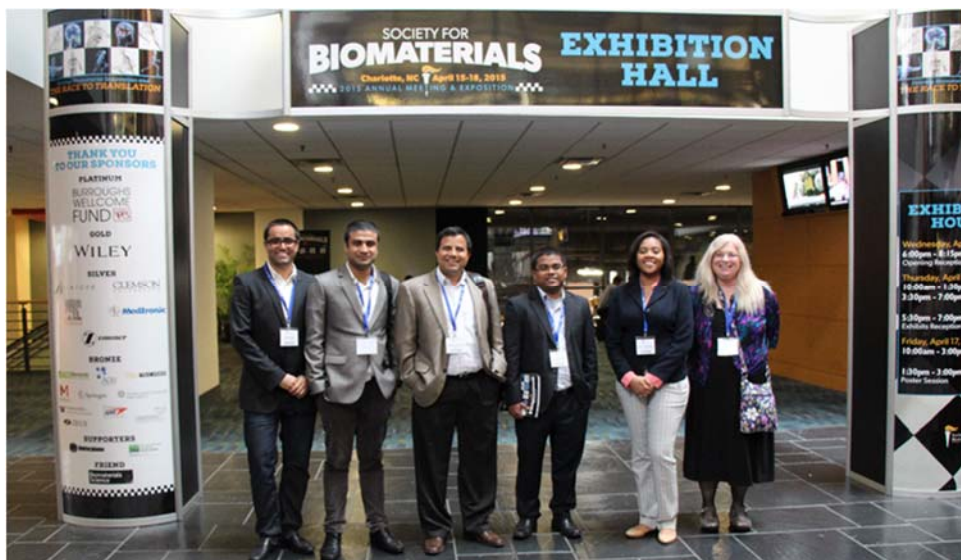
Nanofibrous scaffolds - used in tissue engi-

neering and regenerative medicine and can be efficiently made by the electrospinning process. In this experiment, students modeled the electrospinning apparatus with a cotton candy machine to fabricate sugar fibers.

Microspheres - ideal vehicles to encapsulate pharmaceutical drugs for delivery to various parts of the body. In this experiment, students synthesized microspheres by using cornstarch and tonic water. Cinnamon on a spinning plate represented the addition of drugs to the beads. Students were allowed to choose varying amounts of cornstarch and tonic water.

Nerve guidance conduits - protective shields for nerves undergoing regeneration. In this experiment, students modeled the process of nerve tissue regeneration using a paper towel holder, wire, and light bulb.

- Nava P. Rijal & Udhav Adhikari (NC A&T)



Members of the third place winning team in the Society for Biomaterials "Biomaterials Education Challenge" in front of main entrance at the SFB Annual Meeting. From left to right: Nava Rijal, Udhav Adhikari, Narayan Bhattarai, Shekh Rahman, Zanshe Thompson and Cindy Nelson.

FACULTY ACHIEVEMENT CORNER

The SLC would like to acknowledge some of the accomplishments of our outstanding faculty. It is through their leadership, encouragement, and guidance that we as a student body are able to always perform to our greatest potential.

DR. HARVEY BOROVETZ



Named Faculty Fellow of the University of Pittsburgh Honors College

3 keynote addresses globally

DR. WILLIAM HEINEMAN



Received the ACS Analytical Division Distinguished Service Award in 2015

DR. DHANANJAY KUMAR



Primary organizer of symposium on "Oxide thin films and nanostructures for advanced electrical, optical and magnetic applications," at the Materials Research Society Spring 2015 Meeting

DR. PRASHANT KUMTA



Interviewed for articles on additive manufacturing of resorbable materials by Voice of America, 3DPrint.com and Medtech Insight Magazine

Featured in Pittsburgh Post-Gazette article on academia funding for research and education

DR. DEVDAS PAI



Organized three session topics at the 2014 ASME International Mechanical Engineering Conference and Exposition

DR. JAGANNATHAN SANKAR



Featured as one of the Most Influential Persons of 2014-2015 in the Business Journal – Piedmont Triad of NC

5 keynote addresses globally

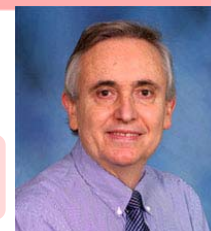
DR. MARK SCHULZ



Was one of eight UC College of Engineering faculty to be recognized as a 2015 Distinguished Engineering Researcher

Received the 2015 UC Established Entrepreneurial Achievement Award

DR. VESSELIN SHANOV



Co-organizer of a new Minor in Materials Engineering at UC

Received the 2015 UC Established Entrepreneurial Achievement Award

DR. WILLIAM WAGNER



Recognized by the University of Pittsburgh with a 2014 Pitt Innovator Award

2 keynote addresses globally

DR. SAVIO WOO



Secured Letter of Intent with Beijing Naton Technology Group, one the largest orthopedic implant companies in China, to partner in development of his group's orthopedic devices.

DR. YEOHEUNG YUN



Named as the first tenured faculty and graduate coordinator for the Bioengineering Program at NC A&T

Lead member of the global standardization committee for biodegradable metal testing

Education and Outreach



North Carolina
Agricultural and Technical
State University

students with their shopping and writing thank-you letters to the program sponsors.

Another year of outreach activities to local elementary, middle, and high school students was accomplished this year at NC A&T! SLC graduate students participated in the Hayes Taylor YMCA Bright Beginnings program, which helps approximately 500 students the opportunity to buy new school supplies, clothes, and a backpack. NC A&T volunteers helped the

NC A&T SLC members also participated in the 2015 Science Extravaganza at Claxton Elementary School, supported by Caterpillar and ASME representatives as well as NC A&T alumni. This year's Science Extravaganza centered on the "Popsicle Truss Bridge Competition". The elementary school students gained knowledge on important concepts and criteria that an engineer must consider when designing a stable bridge. Students generated designs, implemented various manufacturing techniques, and used teamwork to construct their ideal bridge made from Popsicle sticks. The volunteers encouraged the students to problem solve and to be aware of design flaws while building their bridges. At the conclusion of the event, the students were very pleased with the activities and gained a newfound appreciation for engineering.

ERC-RMB students from Dr. Bhattarai's lab also helped arrange several activities as part of the annual North Carolina Science Festival from April 10-26,

2015. Along with Guilford County Middle School science teacher Ms. Cindy Nelson, the graduate students presented an exciting science activity for 3rd-5th grade students from Bluford Elementary School. They translated their exciting biomaterials research into concepts that elementary school students could understand and become excited about. This activity provided an engaging way to relate classroom instruction to real-world biomedical applications and sparked interest in pursuing future studies in STEM. The elementary school students performed hands-on activities to model the electrospinning technology used in research by using a cotton candy machine to fabricate sugar fibers. Students were engaged in learning scientific knowledge with understandable concepts and easy-to-implement experiments, while being able to enjoy some delicious cotton candy!

-Paul McGhee and the
Bhattarai Lab (NC A&T)



Adrianne Williams helping a student with school shopping at the YMCA Bright Beginning program.



Shekh Rahman working with students to design their popsicle truss bridge.



Dr. Bhattarai's lab with students and teachers from Bluford Elementary School.



Dean, a 7th grade science teacher at the school, has maintained a long-term outreach cooperation with ERC-RMB students at the University of Cincinnati. On May 15th, 2015, students from UC, led by Dr. Pixley were invited by Ms. Dean to teach a class for special needs students. The UC participants designed a simple experiment

During Year 7, ERC-RMB students of the University of Cincinnati participated in outreach activities for junior high school students at Mt. Healthy Junior/Senior High School. Ms. Roni

for the special needs students which consisted of using plastic pipettes to determine how much water different paper towels could absorb. The class tested three paper towel brands: Declear, Nutter, and Welsh, whose representatives were invited to attend the class. Simple lab equipment including lab coats, lab goggles, and plastic pipettes were supplied for the class. For the experiments, each group of students were led by graduate students to teach them how to use the pipettes and answer their questions about science. The students wearing white lab coats and goggles took well to this learning experience, working carefully and seriously to analyze their results, hopefully piquing an interest for them to become future scientists.

- Yonghai Zhang (UC)



Yonghai Zhang (second from right) leading a group of students in their experiment.



Middle school students and UC volunteers gathered in the Mt. Healthy library for the hands-on science activity.



University of Pittsburgh

Over the past year, ERC-RMB students at the University of Pittsburgh gave back to the community with a number of education and outreach events. Efforts were led by Andrew Brown and Jonquil Flowers, who is also the Outreach Chair for the Pitt chapter of the Biomedical Engineering Society (BMES).

Once a month, students hosted ice cream socials at the University Place Family House where patients from outside of Pittsburgh reside with their families while undergoing treatment for serious or life threatening illnesses. For these patients fighting their way through treatment, having a chance to socialize with each other and volunteers while enjoying ice cream is always a welcome activ-

ity. Students continued volunteer efforts at the Greater Pittsburgh Community Food Bank, where they sorted, packaged, and distributed donated groceries to local families in need.

Several ERC-RMB students served as judges for the SciTech Days at the Carnegie Science Center on November 4-7, 2014 and March 3-6, 2015. SciTech Days give middle and high school students a hands-on look at various STEM fields with workshops, programs, and interactive exhibits with companies and universities such as Pitt. A similar exhibit was presented at a Career Fair held at the Carnegie Library of Knoxville, where bioengineering principles were taught to local children using "hands-on" demos involving the hand. Jonquil and other students also were invited to STEM Days at the North Hills Middle School where they presented to 7th grade students about bioengineering research projects.

For the fourth year in a row, ERC-RMB students gave a day of seminars to over a hundred high school students at the University of Pittsburgh Health Career Scholars Academy. Andrew Brown, Katie Farraro, Jonquil Flowers, and Danielle Minter provided a background of bioengineering and discussed their research projects. Finally, Andrew Brown served as a lead organizer for the second annual Pittsburgh Healthcare Innovation Case Competition (PHICC), where teams of graduate students were given a problem involving an existing healthcare related technology and were tasked with building a business case around it. Andrew and other SLC students volunteered their time and effort in making this experiential learning event a success. The various education and outreach activities served by Pitt RMB students demonstrate our center's lasting commitment to helping those in need and to reach out to future generations of scientists and engineers.

- Jonquil Flowers, Andrew Brown, Da-Tren Chou (Pitt)



ERC-RMB students Danielle Minter, Da-Tren Chou, and Andrew Brown (second, fourth, and fifth from the left, respectively) volunteering at a panel discussion preparing graduate students for PHICC.

Conferences

*ERC-RMB travels the world to
present its discoveries*

Global Experts in Biodegradable Metals Share Knowledge on the Coast of Italy

Students, professors, and researchers from all over the world representing various universities and companies participated in the 6th Symposium on Biodegradable Metals in Maratea, Italy on August 24-29, 2014. The symposium was led by co-chairs Dr. Diego Mantovani, Dr. Yufeng Zheng, Dr. Mark Staiger, and Dr. Frank Witte, who focused on maintaining a casual academic-conference-style format where open discussions were encouraged and welcomed. The symposium, which focused on novel biodegradable alloys, was divided into 4 different sessions of lectures; metals, corrosion, *in vitro*, and *in vivo*. Each session began with a keynote speaker, such as Dr. Zhao from the Zhongshan Hospital of Dalian University in China who discussed "The ap-

plication of biodegradable magnesium screw in hip surgery", during the *in vivo* session and was followed by shorter oral presentations as well as brief poster pitches. A common theme found amongst each of the presentations was the importance of the development and adherence to standardization protocols to better facilitate navigation through the FDA regulatory pathway. The symposium was even concluded with a final ISO/DIN/ASTM meeting for standardization in biodegradable metals which was sponsored by the medical device company, BIO-TRONIK, which is developing a magnesium based resorbable stent.

In addition to attending the various captivating talks, attendees of the symposium were encouraged to explore the local beaches and

beautiful scenery of Acquafredda di Maratea. A special bus excursion allowed attendees to walk through the streets of Morigerati, a small medieval town, and even hike through the beautiful National Park of Cilento. Concluding the bus excursion was a delicious traditional Italian feast at a small family restaurant in Sapri.

The next symposium for biodegradable alloys will take place in the Riva Marina Resort in Carovigno, Italy from August 23-28, 2015. The symposium will include a workshop entitled "Clinics and Biometals" that will set the theme for the conference to inspire future translational research.

- John Ohodnicki (Pitt)



Participants listening to a presentation in the conference hall.



From left to right: Amy Chaya, Andrew Brown, and Dr. Charles Sfeir from Pitt enjoying the afternoon excursion to Cilento.

RMB Members Attend America's Premier Biomedical Engineering Conference

This past year several ERC-RMB members attended the 2014 Biomedical Engineering Society (BMES) Annual meeting, held in San Antonio, TX. Numerous individuals from fields of research, health care, and academia came to showcase their innovative and thought provoking work at the Henry B. Gonzalez Convention Center. Zanshé Thompson and Roman Blount, IV from Dr. Narayan Bhattarai's lab at NC A&T, were awarded the 2014 BMES Innovation and Career Develop-

ment Award to attend the meeting and were recognized at the conference's Health Disparities Session. This session served to better inform the broader Biomedical Engineering community about health disparities and inequities and the role members can play in fighting them. Jun Ma and Nan Zhao, from Dr. Donghui Zhu's lab at NC A&T, were also present to present their research at the conference. Dr. Wagner from Pitt spent time with the ERC-RMB group from NC A&T while

at the school's exhibitor booth. The conference included many opportunities to attend cutting-edge research presentations, network, and socialize. The conference ended with the BMES Bash, held at the Buckhorn Saloon in the Texas Ranger Museum and ensured that the conference ended on a positive note.

- Roman Blount, IV (NC A&T)

ERC-RMB Members Present at the Society For Biomaterials Annual Meetings

2014

The field of biomaterials is one that is constantly pushing the boundaries of research to develop the next breakthroughs in clinical care, which is why last year's Society for Biomaterials (SFB) Annual Meeting carried the theme of "Pioneering the Future of Biomaterials". Held in Denver, CO from April 16-19, 2014, this premier biomaterials international conference drew many members of ERC-RMB to share our progress with a broader scientific community. Nearly 1000 abstracts were accepted ranging from topics across fields including molecular and cell biology, chemistry, physics, and engineering. The Keynote Address delivered by Michael J. Yaszemski, MD, PhD, of the Mayo Clinic inspired attendees with his revolutionary vision to change how orthopedic and neurosurgical are treated by use of novel

degradable polymers and tissue engineering strategies.

The ERC-RMB was well represented at the meeting, with 17 members having co-authored 9 accepted oral or poster presentations. Among the highlights was a 3rd place finish by University of Pittsburgh graduate students, Amy Chaya and Da-Tren Chou, at the inaugural SFB Business Plan Competition where they presented work on magnesium bone fixation plates and screws, an ERC-RMB project mentored by Drs. Sfeir and Kumta. Attendees also had the chance to network and socialize at the Biomaterials Bash held at the Pinnacle Club at the Grand Hyatt, where they were treated to a brilliant skyscraper view of the city.

2015

The Society for Biomaterials (SFB) 2015 Annual Meeting and Exposition was held at the Charlotte Convention Center from April 15-18, 2015. The conference hosted more than 1,000 biomaterials experts from academia, industry, government and the international biomaterials society.

As the ERC-RMB's work focuses on revolutionizing biomaterials research, this conference was a great opportunity to find out how biodegradable metals and

polymers (natural and synthetics) were used for various applications such as drug delivery, wound healing, and tissue engineering. The ERC-RMB represented the biodegradable metals and polymers community, with graduate students Udhav Adhikari, Zanshe Thompson, Sheikh M. Rahman, Nan Zhao, Jun Ma, Nava P. Rijal, Da-Tren Chou, and Daeho Hong as well as Drs. Narayan Bhattarai, Donghui Don Zhu, William R. Wagner and other ERC-RMB family from the University of North Carolina A&T, University of Pittsburgh, and University of Cincinnati attending the conference to present the ERC-RMB's research accomplishments.

The invited talk at the opening ceremony was remarkable, presented by Director of the Wake Forest Institute for Regenerative Medicine and the W.H. Boyce Professor and Chair of the Department of Urology at Wake Forest University, Anthony Atala, MD. Conference attendees were also treated to a night of fun at the Biomaterials Bash held at the NASCAR Hall of Fame, where they could drive a simulated race car!

The SFB Annual Meeting was a rewarding experience for the students who attended and the SLC hopes to see more members attend this invaluable conference in the years to come. This conference was an excellent opportunity for students to increase networking with industrial and academic pioneers.

- Da-Tren Chou (Pitt), Nava P. Rijal, and Udhav Adhikari (NC A&T)



Representatives from NC A&T at the 2015 poster session, from left to right: Nava Rijal, Cindy Nelson (Teacher from Kernodle Middle School), Zanshe Thompson, Dr. Narayan Bhattarai, and Udhav Adhikari.

ERC-RMB Represented at the ASME Conference in Montreal, Canada

The 2014 American Society of Mechanical Engineering (ASME) International Mechanical Engineering Congress and Exposition (IMECE) was held Palais des Congres convention center in Montreal, Canada from November 14-20, 2014. This conference brought together members of academia, industry, and government to discuss a broad range of Mechanical Engineering topics. The theme of the congress was Engineering for Global Development which included 20 multi-disciplinary tracks with over 2,000 presentations.

The innovations in processing, characterization, and applications of bioengineered materials was represented by the ERC-RMB. The achievement of our center was presented by graduate student Paul McGhee (NC A&T) as well as faculty Dr. Yeoheung Yun, Dr. Devdas Pai, Dr. Svitlana Fialkova from NC A&T.

The keynote event at the ASME conference was the Engineering for Global Development panel discussions on pressing issues in the developing world such as the need of technologies in underserved communities. Panelists also discussed the economic trends in emerging markets, funding mechanisms in social ventures and industrial partnership development. Plenary speaker Chris Van Buitlen, vice president of Sikrosky Innovations, gave an inspirational talk on the history and challenges of innovation within the company. The conference lasted 7 days filled with numerous social and scientific events. At the conclusion of each day, there were opportunities to

explore various tourist sites and local restaurants in downtown Montreal.

The 2015 ASME International Mechanical Engineering Congress and Exposition will be held in Houston, TX on November 13-19, 2015.

- Paul McGhee (NC A&T)



Paul McGhee presenting his work at the ASME Conference.

ERC-RMB

Graduating students & alumni

Bright young scientists move on to the next saga of their promising careers



ERC-RMB alumni Chris Mahoney and Lauren Douglas-Byrd at NC A&T's commencement.

What did you take out of your experience being a part of the ERC-RMB?

Roman Blount, IV (NC A&T)

Roman received his M.S. degree in Bioengineering in 2014 under the guidance of Dr. Narayan Bhattarai. He will begin his medical training this fall at the **University of North Carolina Chapel Hill School of Medicine**.

"Through the collaborative efforts of the ERC-RMB, I have spoken with medical doctors that have merged patient care with engineering research to impact the world. As I learned about their contributions, I strengthened my desire to contribute as well by taking real-world patient issues and blending it with engineering knowledge to address medical concerns as a medical doctor with an engineering background."

Sarah Henderson (Pitt)

Sarah earned her Ph.D. in Bioengineering in 2014 while working in Dr. Almarza's lab, part of the Center for Craniofacial Regeneration.

"The ERC-RMB allowed me to gain a network of colleagues and collaborators for research. The student retreats were fun and allowed for me to gain a more in depth understanding of all the various aspects of research occurring within the ERC."

Danielle Minter (Pitt)

Danielle received her Ph.D. in Bioengineering under the direction of Dr. Kacey Marra in the Adipose Stem Cell Center. She now uses her knowledge of the biotech field and networks in executive search as an Associate within the Biotechnology practice of **Korn Ferry International**.

"My time with the ERC provided me with highly collaborative experiences as well as first-hand lab experience with several different biomaterials. I cherish the new friends and colleagues our Pitt team has forged through the ERC and am excited for the promising RMB future!"

Satish Singh (Pitt)

Satish received his Ph.D. in Chemical Engineer-

ing in 2014, having worked in the lab of Dr. Prashant N. Kumta. He is now a Research Scientist in the New Technology Department at **Avon Products Inc.**

"The ERC-RMB provided me with an opportunity to work with world class researchers and internationally renowned collaborators on developing translatable technology. My involvement with the SLC was a particularly unique opportunity to develop both my project management and leadership skills ultimately preparing myself for the transition from graduate school to a career in industry."

Christopher Smith (NC A&T)

Christopher graduated with a Ph.D. in Mechanical Engineering with a concentration in Biomaterials in May 2014 under the tutelage of Dr. Jag Sankar and Dr. Zhigang Xu. Christopher is currently in the Architecture & Software Leadership Development Program at **Rockwell Automation** as an Associate Engineer.

"The practical experience I received has been invaluable. As a result, my time with the ERC has helped me in my career in terms of being able to handle complex problems and come up with reliable solutions, building confidence in my technical abilities, and leveraging network opportunities to advance my career...To the current students of the ERC, understand that being a part of this program can be challenging and fulfilling only if you take active ownership of your academic research and professional development."

Leon White (NC A&T)

Leon graduated with a Ph.D. in Mechanical Engineering under the direction of Dr. Yeoheung Yun in 2014. He is now in the Professional Development Program at **Northrop Grumman** in Baltimore, MD.

"My experience in the ERC-RMB allowed me

to think BIG PICTURE while seeing things on the global scale. Having the opportunity to travel to Germany and India and work with such a diverse group of individuals daily in the lab has opened my eyes to new possibilities and has certainly shaped my career path."

Adrienne Williams (NC A&T)

Adrienne graduated with an M.S. degree in Bioengineering from Dr. Matthew McCullough's 'BIOFABB' Biomechanics lab. She will be pursuing a Ph.D. in Biomedical Engineering at the **University of Virginia** beginning this fall.

"The ERC-RMB gave me my first experience as a member of a truly interdisciplinary research center. I got to see and learn about various types of really impactful research being done and I am truly pleased that I was able to be a part of it and contribute with my own project. The academic and career building opportunities available to ERC graduate students have definitely prepared me for my PhD and beyond."

Nan Zhao (NC A&T)

Nan graduated with an M.S. degree in Bioengineering in 2015 as part of Dr. Donghui Zhu's lab. He will be continuing his training as part of the Bioengineering Ph.D. program at **Pennsylvania State University**.

"I am really grateful for the opportunity to participate in the cutting-edge research and to work with people from different research backgrounds. During the past two years in the ERC, I not only was able to finish my degree, but also published several research papers as the lead author. The research experience in the ERC has well prepared myself for my long-term career goals."

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<http://erc.ncat.edu>



ERC-RMB students at the Student Retreat.