NSF Engineering Research Center for
Revolutionizing Metallic Biomaterials
http://erc.ncat.edu
NC A&T State University
University of Pittsburgh
University of Cincinnati
Hannover Medical School
ISSUE 4

Newsletter 2013

NSF ERC-REVOLUTIONIZING METALLIC BIOMATERIALS (ERC-RMB) STUDENT ASSOCIATION

From the desk of Director Sankar

Welcome to our fourth student-generated newsletter of the Engineering Research Center for Revolutionizing Metallic Biomaterials (ERC-RMB). The vision of our Gen 3 ERC 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 multidisciplinary and global challenges and opportunities of the new millennium.

Once again this year, the Student Leadership Council has outdone itself in bringing together the numerous details covering various aspects of the Center and rallying behind the Center philosophy "One Team, One Dream". We are excited about the intellectual growth and leadership of our ERC students, our next-generation innovators and thinkers.

In Year 5, the device projects and technology concepts were realigned in an elevator pitch style, with identification of unmet clinical need, market analysis, product/solution and IP position, killer experiments, timeline for translation and exit licensing strategies, venture capital support, acquisition etc. The 3 thrust areas (red, blue and green) also developed a quad chart approach (in a DARPA-required project management style) documenting the overall significance, progress, continuation plan with milestones and SMART (Specific, Measureable, Attainable, Relevant, Timely) deliverables, with project extension decisions based on IP status, clinical and commercial relevance and interactions. These have resulted in key opportunities with selected industries.

Leon White (PhD student) and Hector Carmona (REU from CSULA—ERC outreach partner) won the very first TestBed for Innovation and Translation Competition with their project Biodegradability – *Revolutionizing Metallic Biomaterials*, and Amy Chaya received 3rd place in the Perfect Pitch Competition with her *OsteoMag: Degradable Metallic Bone Fixation* pitch at the 2012 ERC Annual Conference. This is a follow up to Da-Tren Chou's winning of the very first Elevator Pitch Contest, and the Lynn Preston Trophy, at the 2011 ERC Annual Conference. These exemplify the continued excellence of the ERC-RMB student body.

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

ERC-RMB students and faculty at the 4th annual Symposium on Biodegradable Metals in Maratea, Italy (see pages 2-3).

Welcome to the Spring 2013 issue of the student-produced ERC-RMB newsletter. This is an exciting time for our ERC as we continue to increase in both the level of scientific research being performed on our campuses and the impact we have on our communities. The Student Leadership Council (SLC) is pleased to report the outstanding progress of both research activities and educational and outreach efforts.

This issue of the newsletter highlights the global presence, accomplishments, and collaborative research efforts taking place within our dynamic Center. Featured articles include updates on student travel to international conferences held in Italy and India. The strong representation and numerous accomplishments of the SLC at the 2012 ERC Annual Meeting are also highlighted. The SLC was also able to host two separate workshops on Sensors and Craniofacial Devices as sessions during Student Retreats to increase the awareness of research accomplishments and to provide increased opportunities for collaboration among participating institutions.

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

SLC Co-Presidents:

Leon White
North Carolina A&T (NC A&T)

John Vennemeyer
University of Cincinnati (UC)

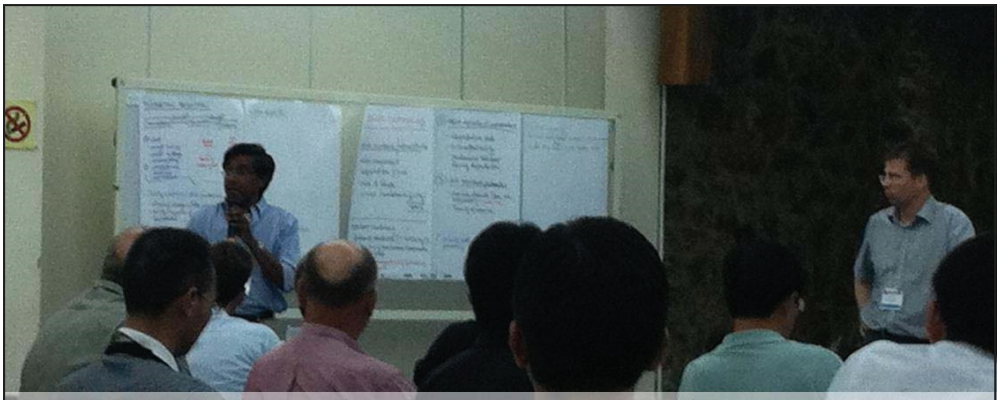
Satish Singh
University of Pittsburgh (Pitt)

ERC-RMB makes waves at the *Symposium on Biodegradable Metals*

Events

ERC-RMB travels the world as a thought-leader in degradable metallic biomaterials

Approximately 80 scientists representing Universities and companies from all over the world gathered in Maratea, Italy from August 27th thru September 1st, 2012 to participate in the 4th Symposium on Biodegradable Metals. The venue for the symposium was the Hotel Villa del Mare, a secluded resort in Southern Italy on the Western Mediterranean coastline. Surrounded by olives and carob trees on a rocky rib between the mountains and the sea, the splendid scenery and isolated location provided the perfect backdrop for discussion on the state of the science of biodegradable metals.



Dr. Sankar (standing, left) contributes to discussion with Dr. Witte (standing, right) during the 'Consensus Meeting for Biodegradable Metal Standards'.

The focus of the symposium was the development of novel biodegradable metals for biomedical applications. Each day consisted of academic-conference-style sessions, focusing on metal processing, metal corrosion behavior and in-vitro and in-vivo assessment of alloy performance. Several ERC-RMB members presented on these topics including Dr. Charles Sfier (Pitt), Dr. Julia Kuhlmann (UC), Dr. Prashant Kumpta (Pitt) and Da-Tren Chou (Pitt). Throughout the week, there were three keynote sessions. The title of the first keynote was "Impurities in the production and processing of magnesium alloys" given by Dr. Norbert Hort, department head of Magnesium Processing of the Magnesium Innovation Center (MagIC) at the Helmholtz-Znetrum Geethacht Centre for Materials and Coastal Research in Geesthacht, Germany. The second keynote was "Investigations of local corrosion processes on biodegradable magnesium alloys using a novel online micro-flow capillary plasma mass spectrometer set-up with electrochemical control" given by Dr. Andrea Ulrich. Dr. Ulrich is a researcher in the analytical chemistry unit of the Swiss Federal Laboratories for Materials Science and Technology in Duebendorf, Switzerland. The final keynote was "Magnesium degradation as seen by artificial neuronal networks (ANN)" given by Dr. Regine Willumeit, who is department head of Structure Research on Macromolecules also at the Helmholtz-Znetrum Geethacht Centre. Attendees were invited to submit manuscripts of their presented work in a special issue of *Acta Biomaterialia*, a leading biomaterials journal edited by ERC-RMB Deputy Director William Wagner, which will be published later this year.

Conference participants prepare for an adventure into the Pertosa-Auletta Caves.

A common theme of all sessions was the standardization of laboratory practices. Standardization of techniques in metal processing and *in vitro* and *in vivo* characterization and testing is currently a major challenge in the field and will be vital for the successful development of biodegradable metals in the future. To begin addressing this, the first 'Consensus Meeting for Biodegradable Metal Standards', led by Dr. Frank Witte from the ERC-RMB, was conducted as part of the symposium. Participants divided into three groups based on expertise (materials, *in vitro* or *in vivo* systems) and

outlined what they felt were the most important hurdles to overcome in the near future. The results of this consensus meeting were presented to the United States FDA at a meeting in November 2012.

One of the biggest perks of the conference was the afternoon 'beach session' that took place each day after lunch. This session was integral in giving participants time to network and establish relationships with other students, scientists and engineers. Toward the end of the week, attendees were taken on excursions to explore the surrounding area, either by chartered yacht up and down the Italian coast or by bus to visit the ancient Pertosa-Auletta Caves and the Padula Charterhouse, one of the largest monasteries worldwide, in the heart of Southern Italy.

For the past four years, this conference has been vital in building the biodegradable metal community, allowing scientists to come together and find ways to innovate and collaborate on a global level. The ERC-RMB is a major contributor to this field and we hope even more of us can make it to 5th annual symposium on Biodegradable metals on Umang Island in Indonesia!

— Christopher Smith (NC A&T) & John Vennemeyer (UC)

Visit **www.conferium.com/WPclients/biomat5/** for more information about next year's symposium!

The entrance of the historic Padula Charterhouse, home of the largest cloister in the world.

ERC-RMB Raises Awareness of Biodegradable Metals by Organizing FDA Workshop

On March 30th, 2012, members of the ERC-RMB participated in the FDA Workshop titled "State of the Art in Biodegradable Metals - A Think-Tank Workshop". Most notably, Dr. Jag Sankar, Director of the ERC-RMB, and Dr. Frank Witte, an international collaborator of the ERC-RMB, served as organizers of the workshop. 9 faculty members and 21 students from the three member institutions (NCAT, Pitt, UC) of the ERC-RMB attended the workshop. Dr. Witte presented an overview of use of metallic materials for biomedical applications, and Dr. William Wagner from Pitt presented an overview of the ERC-RMB, highlighting device applications of the ERC technologies in magnesium. On top of the representation from the ERC-RMB, the workshop featured presentations by the pioneers in the field of biodegradable metals, such as Dr. Diego Mantovani from Université Laval, Quebec, Canada, who pioneered the use of iron alloys for cadiovascular applications. In the workshop, the topics covered ranged from alloy development for medical applications to in vitro and in vivo evaluation of alloys and regulatory hurdles. There were also representatives from industry, including Accel-Lab from Canada, Biotronik from Germany, Synthes from Switzerland, Biomet from the US. There was ample opportunity to meet the industry representatives to discuss potential research collaboration with the ERC-RMB. Dr. Sarka Jeremic from Mg-Elektron from the UK showed a strong interest in orthopedic applications of magnesium alloys. They have since initiated a non-disclosure agreement with Dr. Savio Woo at Pitt to explore potential collaborations. Overall, the workshop provided many opportunities for the ERC-RMB to showcase our excellent work to the FDA and companies from around the world as well as to explore potential leads for collaboration with industry.

— Kwang Kim (Pitt)

Pitt graduate students Kwang Kim (left) and Daeho Hong at the entrance to the FDA White Oak Campus.

One week in India

ERC-RMB creates ties with leading researchers and hospitals in Southern India

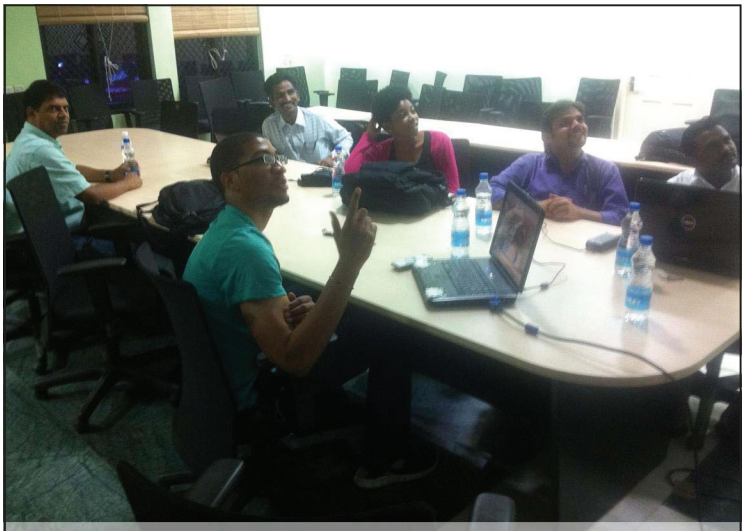
ERC-RMB and IITM students and faculty visit Apollo Speciality Hospital in Chennai.

In October 2012, PhD students Leon White (NC A&T), Venkataraman Giridharan (NC A&T), Da-Tren Chou (Pitt), undergraduate chemical engineering student Brittany Sloan (NC A&T), ERC-RMB Director Dr. Sankar, Director for Education and Outreach Dr. Devdas Pai, and ES-1 Leader Dr. Prashant N. Kumta all visited the Indian Institute of Technology-Madras (IITM) in Chennai, India. They attended the weeklong Workshop on Disruptive Innovation in Healthcare with the following objectives in mind: (a) Observe and frame hypotheses on the biomedical device industry based on data collected during hospital visits and interactions with delivery personnel (clinicians) (b) Interact with faculty and students of IITM (c) Interact with future leaders involved in disruptive health care delivery in India. These objectives were undertaken with the supervision of Dr. Venkatesh Balasubramanian, Associate Professor in the Department of Engineering Design, at 4 locations: Apollo Hospital - a modern hospital which is successful in being a destination hospital for tourists, Hindu Mission Hospital - a 220-bed multidisciplinary health facility, IITM Research Park - a technology park to enable companies doing R&D to have university lab space and leverage the expertise of ITTM, and the Healthcare Technology Innovation Centre (HTIC) - a joint initiative between IITM, the Department of Biotechnology, and the Indian Government to develop technologies to solve the nation's healthcare problems.

Dr. Mohanasankar Sivaprakasam HITC describes the Mobile Eye Surgical Unit developed at the HTIC to Dr. Pai (middle left) and Dr. Kumta.

The workshop included a number of lectures from entrepreneurs and innovators in the medical device field, including talks by entrepreneur Krishna Mahesh and researcher/cardiothoracic surgeon Dr. Soma Guhathakurta. Mahesh, a Harvard MBA graduate, started the Chennai-based Sundaram Medical Devices company, and created a "high-tech, low-cost hospital bed" that incorporates significant design improvements to ease patient pain. Mahesh recognized that manual beds were very difficult to operate and electronic beds were extremely expensive and prone to breakdown. Realizing that a person's hospitalization could more comfortable by improving hospital beds, Mahesh decided to make comfortable, safe and more affordable beds for Indian hospitals.

Dr. Soma Guhathakurta, visiting professor in the Department of Engineering Design at IITM, discussed her exciting, multifaceted research including work on decellularized extracellular matrix xenografts, for a variety of applications such as cardiovascular and bone tissue engineering.



ERC-RMB and IITM students bounce research ideas back and forth.

Gowned up and ready to tour the Hindu Mission Hospital.

This visit also started IITM down a path to become a global cultural exchange partner of the ERC-RMB in order to establish broader knowledge and to create innovative, globally competitive entrepreneurial engineers. The workshop provided students the opportunity to obtain a global perspective on biomedical device design for diverse global markets. By experiencing healthcare environments in India and learning about medical technologies being created at IITM, the ERC-RMB students realized the difference in market needs to be considered when developing new medical devices in India.

— Brittany Sloan (NC A&T) & Da-Tren Chou (Pitt)

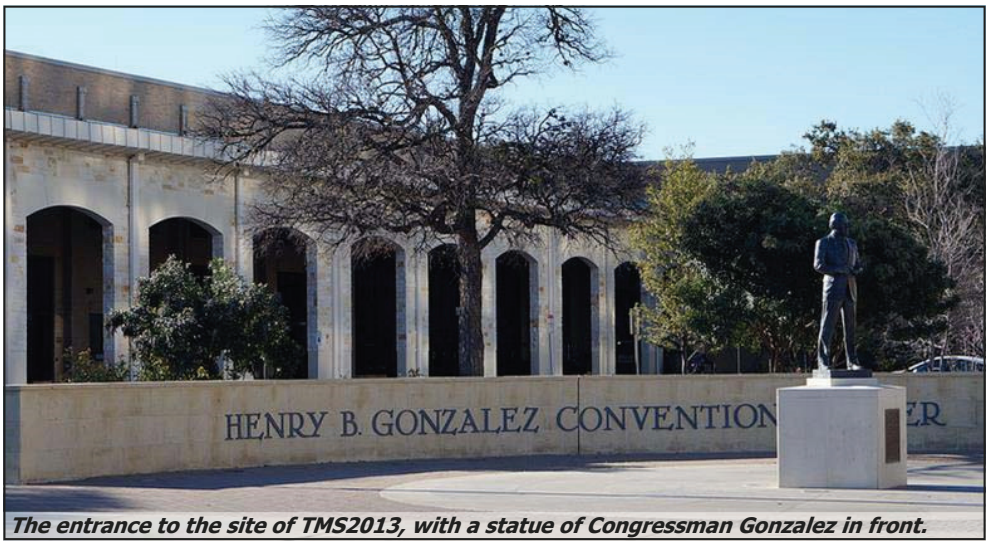
ERC-RMB well represented at TMS2013

The Minerals, Metals, & Materials Society's 2013 annual meeting and exhibition (TMS2013) was held at the Henry B. Gonzalez Convention Center in downtown San Antonio, TX from March 3rd – 7th, 2013. Over 3500 materials scientists and engineers from academia, industry, and government representing over 68 countries attended TMS2013, with a special session called "Magnesium-Based Biodegradable Implants Symposium: Performance Assessment and Evaluation" being featured for biodegradable magnesium (Mg) with more than 50 selected presentations from prominent research institutions worldwide.

The ERC-RMB was well represented at TMS2013, further solidifying the center's place as a leader in the international biodegradable metals community. Graduate students Daeho Hong (Pitt) and Christopher Smith (NC A&T), as well as Dr. Sankar, Dr. Zhigang Xu, and Dr. Dhananjay Kumar from NC A&T attended the conference to present the ERC-RMB's research accomplishments in the Magnesium Implants session chaired by Dr. Frank Witte and Dr. Nobert Hort. As an invited speaker of the session, Dr. Sankar proudly introduced the progress of the ERC-RMB and 4 other RMB talks were presented. Plentiful discussion and comments were exchanged after every presentation, with one of the most interesting discussions about the safety of using aluminum as an alloying element for biodegradable Mg alloys. The conclusion reached from the dialogue was that the amount of aluminum content from aluminum-containing Mg alloys seems insufficient to cause Alzheimer's disease or other possible toxicity and the localized toxicity is likely to be less for stents compared to orthopedic applications due to a higher volume of fluid exchange. Boston Scientific, a global medical device developer/manufacturer, and You&I Corporation, an orthopedic application manufacturer from South Korea, presented their current research status and industrial perspectives in the field of biodegradable Mg.

Overall, growing interest in biodegradable Mg was observed as many new groups from different countries were seen at TMS2013. The special session for biodegradable Mg alloys was a great experience to meet other researchers directly involved in the development/synthesis of Mg alloys since the TMS community, compared to medical societies, and is more familiar with materials researchers. With the success and achievements put on display at TMS2013, it seems reasonable for TMS organizers to carry over the biodegradable Mg session to next year's meeting, TMS2014 in San Diego, CA. Members of the ERC-RMB will plan to attend once again to represent the team and show off the novel progress of the center's sixth year.

— Daeho Hong (Pitt)



The entrance to the site of TMS2013, with a statue of Congressman Gonzalez in front.

ERC-RMB at the NSF ERC Annual Meeting

ERC-RMB students give a strong showing at the National event

***Left to right: Hector Carmona, Dr. Jag Sankar, and Leon White after presenting their winning test-bed,* Biodegradability – Revolutionizing Metallic Biomaterials.**

The ERC-RMB has a commitment to further the professional development of students focused on careers in industry and/or translational academic research. This past year, graduate students Amy Chaya (Pitt) and Leon White (NC A&T) put the mission embodied in this commitment to work, at the NSF ERC Annual Meeting, winning 3rd place in the Perfect Pitch Competition and 1st place in the Test-Bed for Innovation and Translation Competition, respectively.

The NSF held this year's Annual Meeting on November 13th - 16th for all current ERCs in Bethesda, MD to highlight ERC accomplishments, present new strategies for engaging industrial partners, exchange successful education and outreach strategies, and connect students across the various ERCs.

The Perfect Pitch Competition challenged students to address the following three questions in a 90 second "elevator pitch" and single PowerPoint slide: "what real-life problem their research addressed, how they solved it in a unique way, and what impact it would have for society and in achieving their Center's mission". The elevator pitches were evaluated by a panel of judges from industry and the venture capital sector. Amy delivered a charismatic and animated pitch describing a comprehensive solution for bone fracture fixation using a novel design and biodegradable alloys. Her victory netted her a $1,000 cash prize.

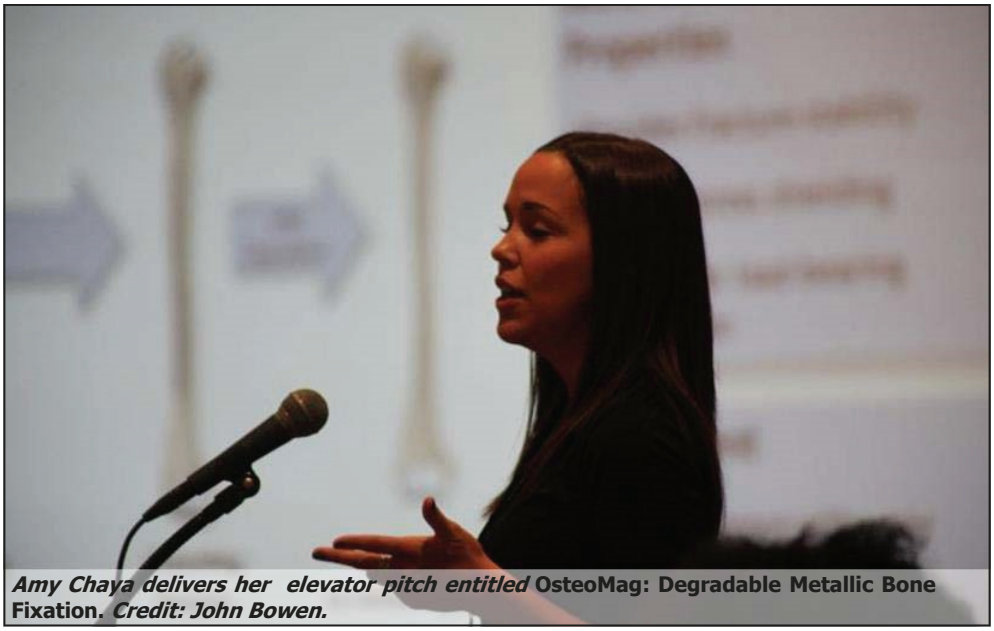
This year, the NSF also hosted its first TestBed competition for Innovation and Translation. Each ERC submitted their top two entries for the competition and the top three among all ERCs were selected to be presented by the students at the Annual Meeting. The contest required that projects involve the development of a system-level test bed aimed at solving an identified problem, in which the students were engaged in the conception, design, or implementation. Leon White and undergraduate Hector Carmona of California State University (an RMB outreach partner) were selected as finalists to present at the annual meeting. The winning test-bed concept, *Biodegradability – Revolutionizing Metallic Biomaterials*, arose under the guidance of the students' scientific advisor Dr. Yeoheung Yun, and center director Dr. Sankar. The concept was closely modeled after the RMB center vision to ensure the test-bed was tied to the center goals at multiple levels.

This testbed concept challenged students to work in synergy to advance research, in this case, Hector developed microfluidics and examined the micro environment while Leon looked at corrosion on the macro scale. Ultimately the two aspects were combined into one test-bed. Specifically, this unique test bed promoted innovation, translational research, economic development, education, next generation workforce, and outreach.

Leaders from the ERC-RMB student leadership committee also contributed to training of new ERC students during a session in the New Center Orientation. The session, co-moderated and organized by Satish Singh, included a presentation by Pitt graduate student Da-Tren Chou entitled "Effectively Communicating ERC Activities and Accomplishments: SLC newsletters and websites". Students from new ERCs benefited greatly by learning from the experiences of established ERCs. Overall, the ERC-RMB SLC was well represented at the Annual Meeting, achieving recognition and success while promoting education during the 4 day event.

— Leon White (NC A&T)

For more about the **ERC Annual Meeting**, including exclusive video coverage, visit — **www.erc-assoc.org/annual_meeting**



Amy Chaya delivers her elevator pitch entitled* OsteoMag: Degradable Metallic Bone Fixation. *Credit: John Bowen.

Education & Outreach

Katie Farraro engages a class full of high school students in a discussion on bioengineering.

NC A&T Graduate student Chris Mahoney (standing second from left) conducting a workshop for area youths.

Graduate Students Reach Out to the Pittsburgh Community in a number of ways

The ERC-RMB student association has been actively participating in local outreach events in combination with Pitt's chapter of the Biomedical Engineering Society, including meeting with the Seneca Valley Medical Careers club and volunteering at the Carnegie Science Center SciTech Festival. Students visited Seneca Valley High School on Wednesday afternoon, February 20th, 2013 to discuss our research to groups of 20 high school students interested in pursuing, of course, medical careers.

Other ERC-RMB members volunteered their Tuesday/Wednesday mornings teaching regional middle school students basics about Tissue Engineering and Regenerative Medicine at the Carnegie Science Center on March 5 & 6, 2013. The volunteers gave a small presentation followed by bone structure engineering activities with 4 groups of students each day.

ERC-RMB 3rd year student, Danielle Minteer, spoke with twenty high school juniors and seniors through the Pittsburgh Tissue Engineering Initiative's Regenerative Medicine Mini Camp for the Connecticut High School Scholar Challenge on February 23rd, 2013 on her research and experiences as an undergraduate and graduate student in Bioengineering.

4th year student Andrew Brown also gave a seminar to 30 undergraduate biomedical engineering students from Robert Morris University. Many of the RMU students focus on design and manufacturing aspects of biomedical engineering, so they were excited to learn more about tissue engineering and regenerative medicine, especially the design and use of degradable metals for fracture healing. One of the RMU students also works as a research student in the lab of Dr. Prashant Kumta!

Many ERC-RMB students participated as category judges at the 74th annual Pittsburgh Regional Science & Engineering Fair at the Heinz Field in Pittsburgh, PA on April 5th, 2013. Categories included Physical Science, Life Science, Biology, Chemistry, Computer Science/Math, Engineering/Robotics, Medicine/Health/Microbiology, and Physics from regional intermediate, junior, and senior high school level students.

For the second year in a row, graduate students were invited to spend a day with over one hundred high school students at the University of Pittsburgh Health Career Scholars Academy. Katie Farraro, Da-Tren Chou and Andrew Brown delivered three interactive presentations to these high achieving students discussing the research and development process that our center performs to transform biodegradable metals into a functioning medical devices. We look forward to meeting the next batch of students this coming summer!

— Andrew Brown & Danielle Minteer (Pitt)

NC A&T Hosts Black Family Technology Awareness Day

The 2nd Annual Black Family Technology Awareness Day was hosted on April 20th, 2013 by the ERC-RMB along with a local professional group from AT&T, Triad Community NETwork. The concept behind Black Family Technology Awareness Day is to expose minority students to science and engineering and increase technological literacy. ERC-RMB students coordinated lab activities and informative workshops for both parents and young students.

The exciting workshops included: an outdoor obstacle course for explaining the oxygenation of blood cells, a wind turbine lab, an antacid reactions lab, a workshop explaining aneurysms and bioengineered scaffolds, a lab explaining the effect of aspirin on blood clots, and a no texting and driving workshop. Each lab introduced a concept from science or engineering to the students such as function and strength of bones, aerodynamics, chemical reactions, pH and how it is measured, bioengineered scaffolds, and anatomy and physiology of the human body. The no texting and driving lab was hosted by AT&T specifically for high school students to bring awareness to the hazards of texting and driving. Other workshops for both parents and students consisted of a scholarship workshop led by NC A&T and a technology workshop by AT&T for current technologies in education as well as their applications in STEM areas. All these outreach events provided an opportunity to introduce the idea of STEM to middle and high school students.

— Leon White (NC A&T)

Student Retreats

The past year saw the student association continue momentum by gathering together to develop research plans, facilitate collaboration, and standardize protocols. This year, students convened in Cincinnati and Pittsburgh for retreats organized in conjunction with scientific meetings.

Each student presented a poster on their research to give everyone a chance to talk about their work.

Cincinnati

ERC-RMB's student association held its fourth Student Retreat on September 13th - 15th, 2012 in Cincinnati, OH. The two day meeting included a Magnesium-Based Sensors Workshop with invited faculty and speakers. The Sensors Workshop was organized by Drs. Mark Schulz and John Yin, and educated participants on sensor applications in order to stimulate them to utilize these novel sensors in their own work. First, presentations were made by recent UC graduates Dr. Julia Kuhlmann and Dr. Xuefei Guo, Dr. Madhumati Ramanathan, and Dr. Yeoheung Yun to get the audience up to speed on the fundamentals of different areas of sensors relevant to the ERC-RMB. Faculty members Drs. Dong, Heineman, Shannov, Schulz, and Bhattarai then chaired a panel to discuss the current state of sensors needs for materials development, biocompatibility and toxicity evaluation, medical devices. Numerous faculty members, including Dr. Frank Witte, ERC-RMB global coordinator, called in to join the other faculty and students in the panel discussion. After a tour of Dr. Heineman's Chemical Sensors and Biosensors Group, Nanoworld Lab, and other state-of-the-art equipment at UC, the Sensors Workshop concluded and student activities began.

To kick things off in the afternoon, an 'elevator pitch' competition was held to select one finalist who would have the honor of representing the ERC-RMB in the NSF ERC's Perfect Pitch Competition later in the year (see page 6). Five students gave their 90 second pitch of their research in this hotly contested competition: Amy Chaya (Pitt), Katie Farraro (Pitt), Kwang Kim (Pitt), Chris Mahoney (NC A&T) and Danielle Minteer (Pitt). The panel of judges: Dorothy Air (Entrepreneurial Affairs and Technology Commercialization, UC), Jason Heikenfeld (Engineering Faculty/entrepreneur, UC), Chris Nawalaniec (Stedman Machine) and Geoffrey Pinski (Intellectual Property Office, UC) selected Amy Chaya as the winner, who ended up doing the ERC-RMB proud by winning 3rd place in the national Perfect Pitch Competition!

The rest of the afternoon was devoted to research updates, with attendees of the Symposium on Biodegradable Metals (see pages 2-3) highlighting the most salient research from the leading conference on degradable metallic biomaterials, followed by updates by student directors for each ERC-RMB research thrust, as well as a poster session where each student could provide a research update on each individual project.

Dr. Sarah Pixley finished the afternoon with a candid discussion on professional development and important issues to consider when nearing graduation based on her own experiences and wisdom. Students were engaged throughout the back and forth conversation and Dr. Pixley provided valuable insight on topics ranging from potential pitfalls for women and minorities in engineering to salary negotiations to parallels between running a lab and running a small business.

After a night of socialization including a dance competition, students broke into small working teams the next morning to go over progress and future plans to accomplish. Following ERC tradition, a thorough SWOT analysis was conducted to gauge the current strengths, weaknesses, opportunities, and threats of the research center to compare areas of improvement over the past and areas where further progress still had to be made. By the end of the two day excursion, the students came away with a greater knowledge of research being conducted throughout the ERC-RMB while also taking away wisdom and experience from the additional activities organized by the student leadership committee.

— Da-Tren Chou (Pitt) &
Yonghai Zhang (UC)

***Graduate student Andrew Brown (Pitt) presents his work entitled* Developing a Dynamic Reactor.**

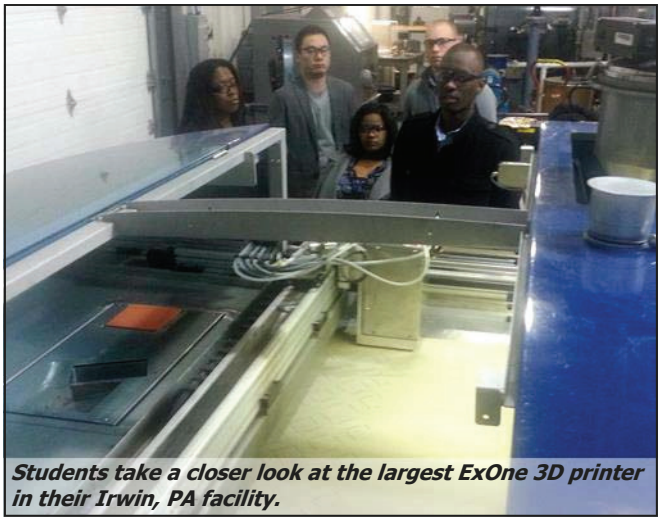
Judges of the elevator pitch competition taking note during one of the presentations.

Pittsburgh

On April 4th-6th, 2013, the ERC-RMB student retreat was held in Pittsburgh, PA. Upon arrival, students gathered in the bustling South Side neighborhood and enjoyed the fine dining and surprisingly pleasant Pittsburgh weather. New students of the center were introduced and old friends caught up and mingled. After dinner, students were invited to the home of Sarah Luffy, a recent RMB graduate from Pitt. Located on Mount Washington, the height of her house allowed the students to get a spectacular view of downtown Pittsburgh, with glistening lights from buildings illuminating the night sky.

Dr. Charles Sfeir, the director of the Center for Craniofacial Regeneration (CCR), kicked off the Craniofacial Device Workshop, the scientific workshop held on day two of the retreat. Dr. Sfeir's informative talk simply entitled "Why Craniofacial?" involved great interactions with students and fit perfectly with the theme of the retreat. Directors of each research thrust then reported on their new research findings, updated by students and faculty members. Knowledge was obtained and discussed by every student in this professional yet relaxing learning environment. The morning section was concluded by Dr. William Chung, a professor from the Department of Oral and Maxillofacial Surgery of the University of Pittsburgh School of Dental Medicine, who transfixed everyone's attention with his exciting research on MatriDisc™, an inductive scaffold for reconstruction of the temporomandibular joint (TMJ) meniscus.

In the afternoon, students were treated to a visit to ExOne, a 3D printing company in nearby Irwin, PA. Not only were the innovative 3D printing techniques and their applications explained by the welcoming ExOne staff, but a tour inside their facilities enabled students to visualize and reinforce the concepts behind 3D printing and see parts being manufactured at different stages of the production line. The whole group was fascinated by the variety of materials the company could apply for fabrication, and the products ranging from delicate artwork, medical prosthetics, to industrial machine parts that ExOne could produce to satisfy requests from diverse business sectors. Every student left ExOne not only with a better understanding and appreciation of the upward trending 3D printing technology, but also with their very own 3D printed souvenirs generously provided by the company.

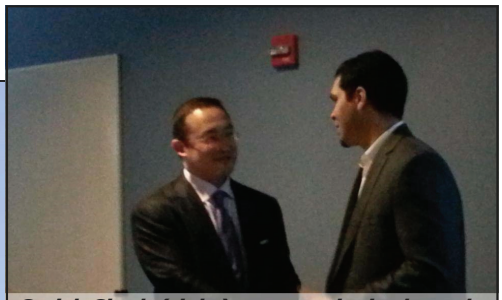


Students take a closer look at the largest ExOne 3D printer in their Irwin, PA facility.

After dinner in Pittsburgh's trendy Shadyside neighborhood, a Tetra-Team Tournament was introduced for the first time in a RMB student retreat. All students from the three universities were randomly divided into four teams and competed in several competitions to test wit, dancing skills, and knowledge gained from the earlier Craniofacial Device Workshop. These games helped students from each school to better know one another, unite more tightly, and further embody our ERC-RMB motto, "One Team, One Dream!"

During the last day of the student retreat, the RMB students attended Bioengineering Day organized by the Pitt chapter of the Biomedical Engineering Society (BMES). It created an opportunity for RMB students to interact with Pitt bioengineering students and professors to discuss their research and learn about innovation, entrepreneurship, and commercialization from a panel of bioengineers-turned-entrepreneurs. The retreated concluded with a poster session and individual thrust meetings to discuss plans moving forward. With strengthened friendships, everyone was looking forward to the next student retreat at Greensboro and more research coordination in the future.

— Dandan Hong (Pitt)



Satish Singh (right) presents invited speaker Dr. William Chung with a token of appreciation after his thought-provoking talk.

Students gather outside the ExOne headquarters after a visit to the 3D printing company.

ERC-RMB
Graduating students & alumni

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

Chris Mahoney and Lauren Douglas-Byrd at NC A&T's commencement ceremony this May.

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

"I enjoyed being able to ***begin a new project from scratch*** and to see it ***flourish into an ongoing project to improve peripheral nerve gap damage***."
- Angela Edwards, M.S. in Bioengineering, North Carolina A&T State University

"The ERC has provided a unique graduate school experience for me, as a part of the program ***I have had the chance to expand my network and work as a part of a multidisciplinary team***."
- Nevija Watson, M.S. in Bioengineering, North Carolina A&T State University

"I enjoyed most being a part of the ***comradely among students*** across all universities that grew during Student Day retreats, Site Visit Programs, trans-ERC courses, and collaborative research. ***These relationships will surely last the course of my career***."
- Christopher Mahoney, M.S. in Bioengineering, North Carolina A&T State University

"Working with the ERC has been an ***eye opening experience*** that has ***broadened my views of research and networking***. "
- Shakiri Jones, M.S. in Bioengineering, North Carolina A&T State University

"The ERC has provided me with ***exceptional opportunities to develop as a professional and a scientist*** along with the chance to form friendships with other students from all over the world. ***One Team, One Dream!***"
- John Vennemeyer, Ph.D. in Biomedical Engineering, University of Cincinnati

Alumnus highlight: **Matthew Fisher**, who received his Ph.D. in 2010 in Bioengineering under the direction of Dr. Savio L-Y. Woo at Pitt, co-authored a comprehensive review with Dr. Robert Mauck on tissue engineering and regenerative medicine. The article, featured in *Tissue Engineering Part B*, discusses advances in tissue grafts, materials, and scaffolds for tissue formation, highlighting findings in recent clinical trials. Matt is currently a post-doctoral fellow in Dr. Mauck's lab at the University of Pennsylvania. Nice work, Matt!

Deputy Director Dr. Wagner (left) and Executive Director Dr. Borovetz visiting Medtronic in Santa Rosa, CA. The goats in the background are used to keep grass short to prevent wildfires.

VISIT US ON THE WEB!

http://erc.ncat.edu/
http://erc-rmb.org

A view from Sarah Luffy's home atop Mt. Washington, Pittsburgh overlooking the scenic Pittsburgh skyline during the Student Retreat.