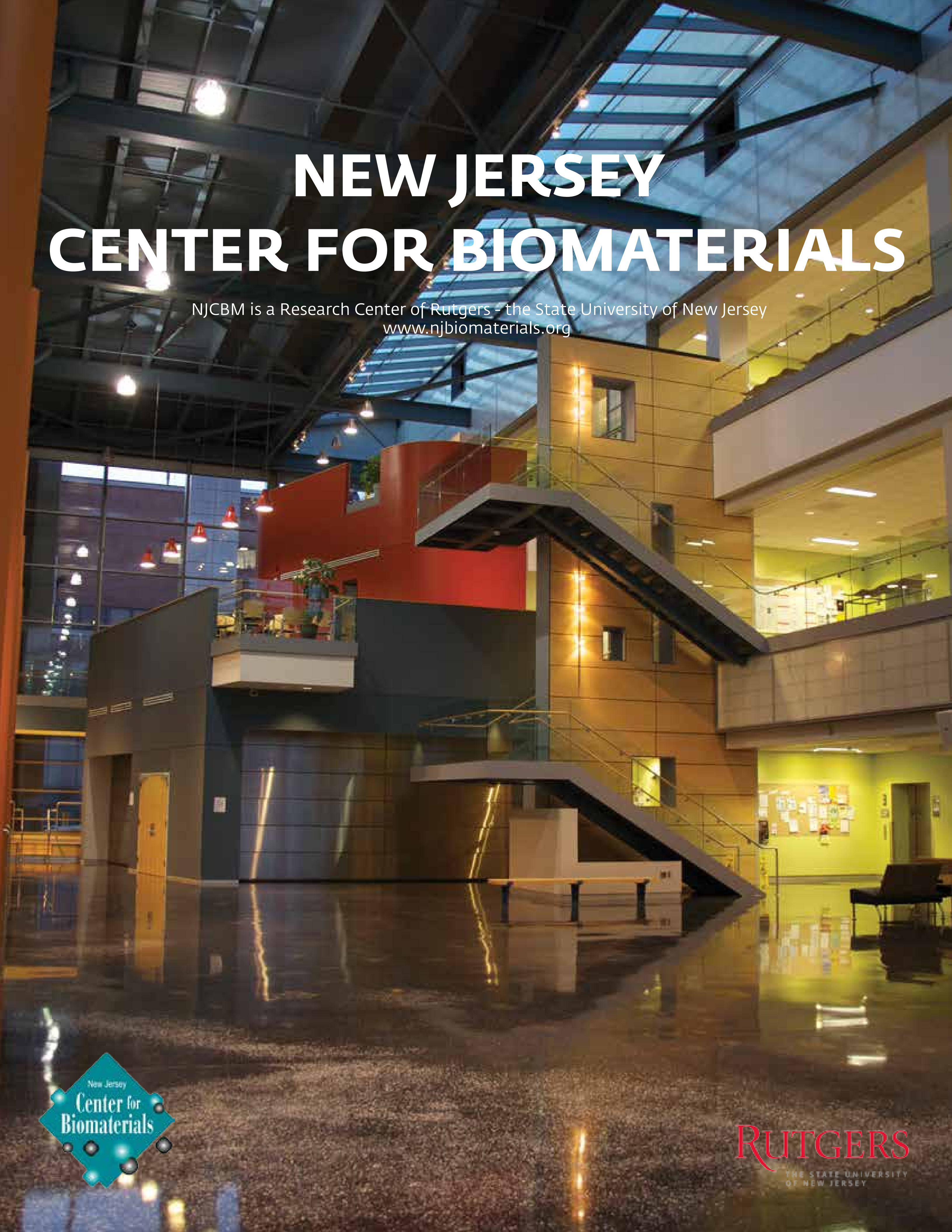
NEW JERSEY CENTER FOR BIOMATERIALS

NJCBM is a Research Center of Rutgers - the State University of New Jersey
www.njbiomaterials.org

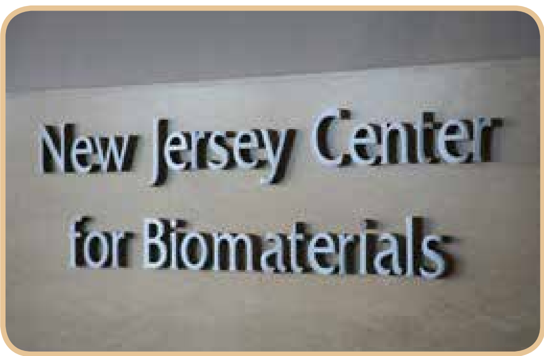


New Jersey Center for Biomaterials

RUTGERS
THE STATE UNIVERSITY OF NEW JERSEY

Director's Message

Welcome to the New Jersey Center for Biomaterials, NJCBM. We are an interdisciplinary research center- based at Rutgers- The State University of New Jersey- that spans academia, industry and government. As biomaterials scientists, our goal is to conduct state-of-the-art research in biomaterials science and engineering and to improve health care and the quality of life by developing advanced biomedical products for tissue repair and replacement, and the delivery of pharmaceutical agents. Our technologies have been translated into pre-clinical and clinical products, including an antimicrobial implant for the prevention of pacemaker infections, a surgical mesh for hernia repair, a fully resorbable and x-ray visible coronary stent, a bone regeneration scaffold and an ocular drug delivery system for the treatment of inflammatory eye disorders.



In today's world, expanding the boundaries of knowledge through research and driving biomedical innovation demands collaborations; merging of disciplinary points of view, partnerships between public and private entities, and increasingly, interactions that bridge regional and national borders.

Our leading research program, RESBIO, integrates the work of chemists, materials scientists, biologists and biomedical engineers toward development of bioactive scaffolds for tissue engineering. Our postdoctoral education program creates a geographically disbursed training community focused on translational research for regenerative medicine. Our leadership of the Rutgers Cleveland Clinic Consortium of the Armed Forces Institute of Regenerative Medicine, AFIRM, has built strong working relationships across a network of academic investigators, clinicians, military medical staff and companies.


Joachim Kohn, PhD, FBSE
Director

NJCBM also reaches beyond the USA to work with scholarly biomaterials societies across the world to promote advancement of the field and especially to develop new collaborations through international student exchange programs. Thus, we build for the global future where research partners may be located not only in different countries but on different continents.

Indeed, such a global outlook on the future of biomaterials science feeds into NJCBM's research collaborations and it interactions with industry. Our industry network and our Center for Dermal Research are the two key entry points for companies to work with us. Our NIH funded RESBIO program is the key mechanism for the establishment of academic collaborations. I invite you to contact me to explore ways in which we can work together.

Sincerely,
Joachim Kohn, Ph.D., FBSE
Director, the New Jersey Center for Biomaterials
Board of Governors Professor,
Rutgers, The State University of New Jersey

Major Accomplishments and Research Activities

The scientists at the NJCBM are a highly interdisciplinary group consisting of polymer chemists, material scientists, cell and stem cell biologists, biomedical engineers and industrial scientists with expertise in product development. Together, our scientists can address a wide range of research challenges. As outlined in more detail below, our scientists have developed tools for the design and optimization of polymeric biomaterials. These tools include parallel synthesis of hundreds of polymers in an automatic synthesis platform, development of combinatorial libraries of biomaterials, the use of computational modeling of polymer properties, and imaging techniques for the prediction of stem cell differentiation under different culture conditions (in collaboration with Prabhas Moghe, Biomedical Engineering, Rutgers University). Using these approaches, biomaterials with tailored properties were created that satisfied the requirements of specific biomedical applications such as an antimicrobial sleeve to prevent infections in patients using pacemakers, a fully resorbable coronary stent and a biodegradable drug delivery system for the long-term treatment of inflammatory diseases of the eye. In conducting their research, the faculty and students at the NJCBM combine excellence in basic science with highly focused application-driven research.

Tyrosine-derived polymers

Poly(amino acid)s, the conventional polymers made of natural amino acids are usually inractable materials that have found sublimited practical applications. However, by modifying the way the amino acids are incorporated into the polymer backbone, Joachim Kohn and his students developed an entirely new class of polymers that combine the non-toxicity of natural amino acids with the favorable materials properties of common engineering plastics. In this way, tyrosine-derived poly(carbonate-amide)s, polyarylates, and most recently new poly(carbonate-ester)s were identified that were further optimized for use in a wide range of medical implants.

The material scientists at the NJCBM quickly realized that more than 10,000 potentially useful polymer structures can be prepared by using L-tyrosine and some of its derivatives as monomers. To explore this large number of polymers, it became necessary to develop a number of new approaches. Together with Doyle Knight and William Welsh, Joachim Kohn is recognized as the pioneer in developing combinatorial and computational tools for the rapid discovery of optimized polymer compositions. This seminal work has been published in a series of widely cited manuscripts. Currently, the NJCBM offers several polymer libraries with optimized chemical compositions for licensing or for academic collaboration.

Exploring cell-material interactions

The close integration of material scientists and biologists is one of the great advantages of working at the NJCBM. Due to this interdisciplinary environment, scientists from the NJCBM have made significant contributions to understanding the interactions between cells and biomaterials. For example, the process of cell spreading over biomaterials surfaces was explored in collaboration with the late Malcolm S. Steinberg from Princeton University. Creating a library of cell growth substrates with different levels of adhesivity and a set of engineered cells which expressed different levels of N-cadherins on their surface, Steinberg and Kohn showed how cell-material adhesivity and cell-cell cohesivity contribute to the rate and extent of cell spreading on any given substrate. The main outcome of this study is a way to predict if a given cell type will attach and spread on a given substrate. More recently, an extensive collaboration with Professor Moghe resulted in the development of powerful, new imaging tools that allow the prediction of stem cell differentiation and stem cell fate when stem cells are cultured on different biomaterials substrates. As a third example, our collaboration with Christopher Chen (Boston University) looks at ways to quantify the mechanical forces that influence cell behavior in in vitro culture systems.

Point of Contact: **Dr. Lauren Macri**, *email: Macri@dls.rutgers.edu; tel. 848.445.9571*

Applications and Product Development

The NJCBM has created a highly conducive environment for translational research and commercialization. At any given time, several former high-level industrial research managers work as research faculty at the NJCBM. We have a certified EN/ISO-14644 Class 7 (US Federal Standard 209 Class 10,000) clean room, a large-scale polymer synthesis facility, and a set of industrial size polymer fabrication instruments. Most recently, an industrial scale extruder (Alex James and Assoc., Inc.) was installed at the NJCBM. This infrastructure makes it possible for NJCBM's scientists to advance their research projects beyond the limits of traditional academic research.

Bone fixation devices

Researchers at the NJCBM have fabricated new bone fixation devices including anchors for rotator cuff repair and other tendon and ligament reconstructions. These devices are made of polymers that are highly bone compatible, osteoconductive and degrade into non-acid degradation products. These devices avoid the late inflammation response sometimes seen with PGA or PLA base implants. Pins, screws, intramedullary rods, and plates have been fabricated using extrusion of injection molding. Animal studies have confirmed that these devices are highly compatible with bone tissue.

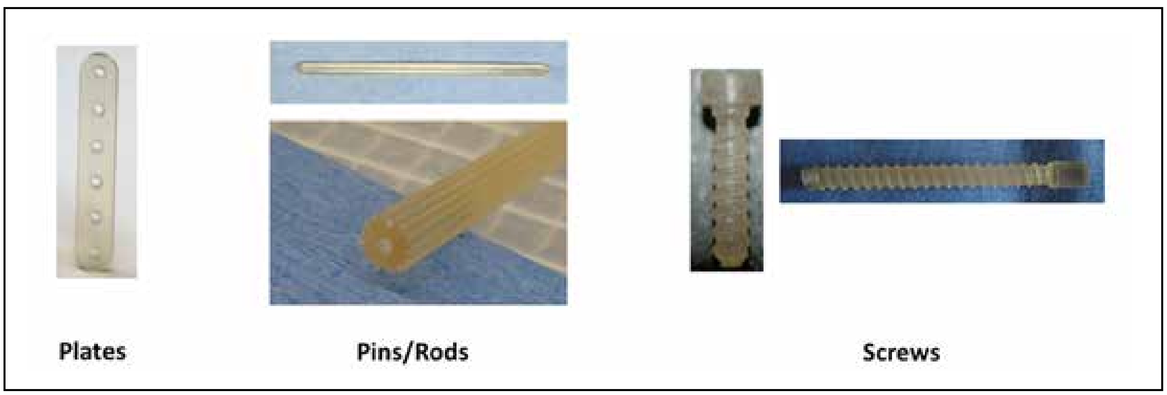
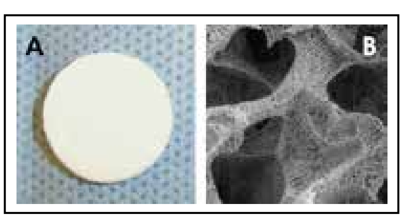


Figure 1: The images shown here are laboratory prototypes, demonstrating proof-of-concept.

Bone regeneration scaffolds

Using a combination of porogen leaching and phase separation, a new fabrication technology for bone regeneration scaffolds was developed. These scaffolds feature a bimodal distribution of macropores and micropores. Together with the use of a highly osteoconductive polymer composition, this architecture results in effective and rapid bone formation in vivo. The scaffolds have been competitively evaluated against a number of clinically used bone void fillers. Extensive sets of test data in the rabbit calvaria critical size defect model confirm the promise of these new scaffolds for use in new bone regeneration therapies.

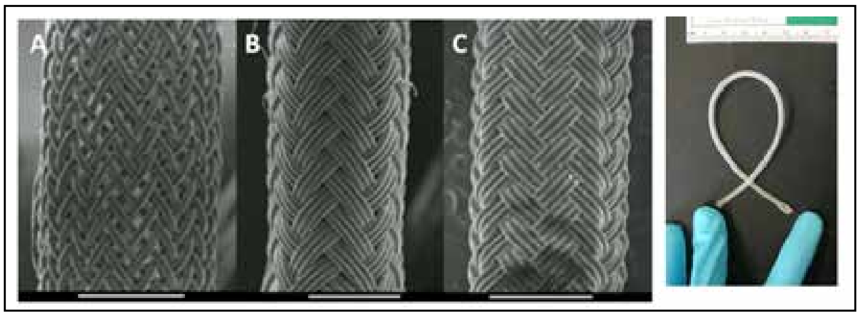


A: Bone regeneration scaffolds made of tyrsoine-derived polycarbonates as disks, plates, or strips of a highly porous material that can be cut to size by the surgeon in the operating room, followed by press-fitting the implant into the bone defect.

B: Microscope (SEM) image of the implant of Figure A. The micrograph illustrates the unique pore architecture consisting of a bimodal pore distribution of macropores and micropores and a highly organized microstructure. Note that the micropores are aligned in an orderly fashion

Conduits for peripheral nerve repair

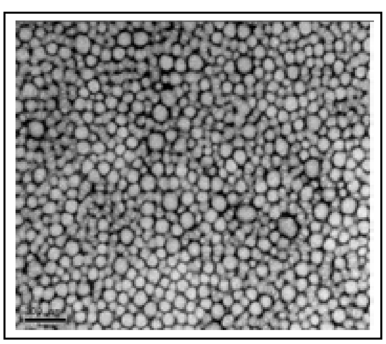
Scientists at the NJCBM are developing flexible, kink-resistant, porous nerve guides. The nerve conduits are fabricated by tubular braiding of tyrosine-derived polycarbonate fibers. First, polymer powder is melt extruded using an industrial scale extruder to form fibers. Fibers are then twisted and braided over a mandrel with an outer diameter matching that of native nerve. To date, bench-top studies and in vivo studies in rodent models have confirmed functionality and utility of braided nerve conduits.



Scanning electron micrographs of three braided conduits using a different number of polymer filaments in the yarn. (A) Single-filament yarn, (B) Three-filament yarn, (C) Triaxial braid with three-filament yarn and longitudinal fibers running along the conduit axis. (Scale bars = 1 mm) (D) Braided conduits bent on wires are extremely flexible and kink-free.

Nanoparticles for drug delivery

Scientists at NJCBM have also developed a new type of degradable nano particular carrier, referred to as TyroSpheres. TyroSpheres are formed when tyrosine-derived ABA triblock copolymers are allowed to self-assemble in aqueous media. In the presence of hydrophobic drugs, these drugs are incorporated into the TyroSphere during the self assembly process. TyroSpheres have an average diameter of 80 nm. Due to an extremely low CAC, TyroSpheres are stable when highly diluted. Over 20 different drugs (cancer therapeutics, vitamins, nutraceuticals, natural products, antimicrobial agents, fluorescent model compounds) have been formulated in TyroSpheres. Several papers describe the anticancer activity and toxicity benefits of paclitaxel-loaded TyroSpheres in comparison to the clinically used Cremophor-Paclitaxel formulation. Additional publications describe the advantages of topical applications of drug-loaded Tyrospheres in several animal models.



Transmission electron micrograph of tyrosine-derived polymeric nanospheres dispersed in buffer and dried on gold grids. Negative staining with uranyl acetate was applied. Scale bar = 100 nm.

These nanospheres self assemble, making it possible to use a very cost-effective, reagent free manufacturing process

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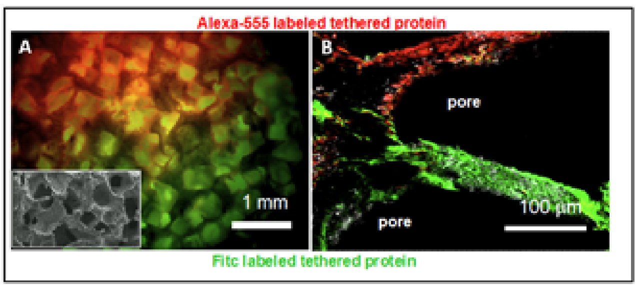
Alveolar Bone And Tooth Constructs

In the United States, more than 70 million adults are potential candidates for dental implants. Approximately 5 million implants are placed each year, which results in 1 failure every 4 minutes. Implant failure is a major concern because re-implantations are increasingly difficult. Funded by the Department of Defense's Armed Forces Institute of Regenerative Medicine II, this project aims to develop bioresorbable scaffolds that promote alveolar bone and tooth formation using autologous and/or allogeneic dental progenitor cell populations. The research team at the NJCBM is developing biphasic scaffolds that are able to regenerate tissue interfaces, such as the interface between bone and teeth. The biphasic scaffolds are fabricated as a single scaffold with two distinct polymer layers, one that supports the growth of one tissue type (e.g., bone), and the other that supports the growth of another tissue type (e.g., teeth). In this way, a scaffold with two well-integrated, yet distinct regions is obtained. The zone of integration is well defined and discrete. The long-term objectives of this project are to demonstrate safety and efficacy in small and large animal models. This work is a collaboration between Dr. Joachim Kohn's laboratory at the NJCBM and Dr. Pamela Yelick's laboratory at Tufts University.



Spacial tethering of ligands within a single scaffold. (A-B) Confocal images of different fluorescent proteins tethered in a single scaffold forming a distinct interface, inset SEM in A shows pore structure.

Craniofacial and Long Bone Defects

According to the American Association of Orthopaedic Surgeons, musculoskeletal conditions in the United States cost society more than $200 billion in medical care and lost productivity. Although orthopedic injuries in the civilian population are quite common, complex and extensive military combat-related orthopedic injuries (e.g., large gap defects) have increased the challenges of orthopedic treatment. Polymeric biomaterials have been successfully used in orthopedic applications, but are effective only as treatments for small bone defects (less than 3 cm). The team at the NJCBM aims to design, fabricate, and evaluate bioactive polymers to be used in polymer-based orthopedic devices that will speed healing of large bone defects (greater than 3 cm), while reducing both pain and medical costs. Funded by the Department of Defense's Armed Forces Institute of Regenerative Medicine I and II, these projects aim to develop a scaffold for repairing large gaps in the cranium and long bones. This project brings together leading academic and military research laboratories and clinicians combining world-class expertise in materials science, polymer chemistry, engineering, and biology. The research objectives of this project are to demonstrate safety and efficacy in large animal bone defect models.

A) Photograph of tyrosine-derived polycarbonate bone regeneration scaffolds of varying dimensions fabricated by a combination of phase separation, freeze-drying, and salt-leaching. B) Scanning electron micrograph of tyrosine-derived polycarbonate bone regeneration scaffolds showing both macropores (for cell infiltration) and micropores (for diffusion and exchange of nutrients and waste).

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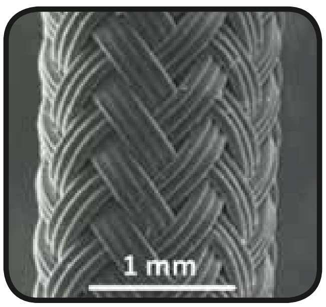
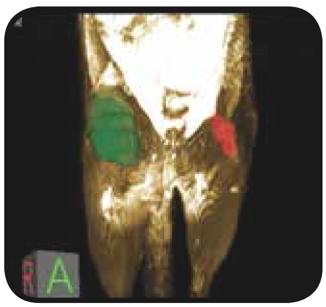
Neuroscience Initiatives

The NJCBM has a world-class neurosciences thrust, working in 4 cutting edge areas of research and collaboration across both the central and peripheral nervous systems. We encourage interested scientists to reach out and participate by collaborating or potentially joining this very strong effort.

Bioengineering Research Partnership

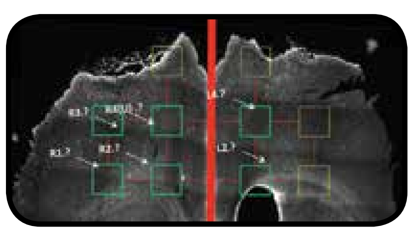
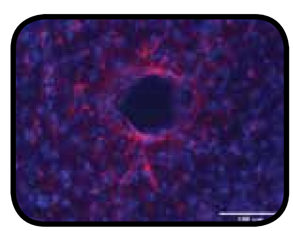
Peripheral nerve injuries require regeneration across gaps to their target muscles. Conduits provide a desirable alternative to autografts, but recovery across gaps is of poor quantity and quality, and much of it is misdirected. Funded by the NIH's National Institute of Neurological Disorders and Stroke, this collaboration combines three technologies invented at Rutgers toward translation of a device for repairing these large gaps. Neurobiology, biomaterials and bioengineering researchers are conducting laboratory and preclinical studies to create a prototype of an off-the-shelf nerve regeneration conduit for peripheral motor nerves, that not only enhances the rate of regeneration, but also the accuracy of motor pathways.






New Jersey Commission on Spinal Cord Research

Microelectrodes for recording and stimulation offer a functionally ideal Brain-Machine Interface to overcome paralysis in spinal cord injury. Due to their rigidity and size, however, they usually only last weeks to months, leaving them clinically useless. This project joins forces between NJCBM's biomaterials scientists and Rutgers biomedical engineers, to develop novel probes that are so small and flexible that they aim to reduce chronic gliosis (scarring), in order to remain functional for years. Our novel, tyrosine-derived, degradable polymer coating temporarily stiffens these fine flexible neural probes so that they can be inserted into the brain, and then resorbs within hours!

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Osteo Science Foundation

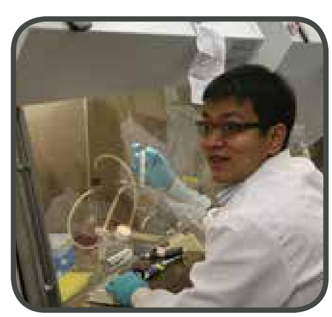
In traumatic craniofacial injuries and massive burn scarring, quality of life is dependent on restoring form and function. Regeneration within the scarred soft tissues and large bony defects is highly dependent on robust vascular supply and sensory-motor reinnervation. This project aims to decellularize neurovascular bundles so that they can be re-endothelialized and then transplanted into large areas of avascular, asensate and/or paralyzed scar tissue, so that these defects may be successfully reconstructed. By providing vascularized nerve grafts of required diameter and length, large peripheral nerve gaps can be repaired; engineered tissues can be innervated and vascularized; and blood supply and sensation can finally be returned to scarred or irradiated tissue beds.

RUNEG - Rutgers University Neuro-Engineering Group

The mission of the Rutgers University Neuro-Engineering Group is to facilitate translational research for the development of devices that enhance central and peripheral nerve regeneration, restoration of motor and sensory function, and transmission of neural signals by brain-computer interfaces. While focusing on biomaterials science and the engineering disciplines, RUNEG brings together researchers from neuroscience, chemical biology, imaging, stem-cell technology, nanotechnology, and computational modeling, as well as physicians.

RUNEG fosters collaborative and interdisciplinary research efforts to enhance understanding of the multidisciplinary field of neural engineering, devices, and cellular therapies to enable the translation of technology from bench to bedside. The group seeks active participation from the members of the biomedical device and pharmaceutical industries to accelerate the transfer and commercialization of inventions and technologies into clinically useful products and therapies through a streamlined approach. An important objective of RUNEG is to provide cutting-edge training and education, in the form of seminars and annual workshops, delivered by world-class investigators both within RUNEG as well as from invited leaders in their fields.





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RESBIO - Integrated Technologies for Polymeric Biomaterials, Bioactive Scaffolds and Cell-Biomaterial Interactions

RESBIO is a NIH-funded national biomedical technology resource that fosters multi-disciplinary investigations and multi-institutional collaborations that integrate chemical, biological and materials research to advance the discovery of polymeric biomaterials for regenerative medicine, the delivery of biological agents, and the development of bioactive scaffolds and medical implants. The overarching aim is to supply biomedical researchers with the biomaterials, bioactive scaffolds and medical implants and tools for studying cell-biomaterial interactions that will enable new medical therapies. RESBIO has been funded by the NIH since 2003 and is currently in its third five-year phase.

RESBIO's goals in Phase 3 (2013 – 2018):

1. Develop biomaterials and bioactive scaffolds based on combinatorial and computational approaches to enhance cellular activity.

2. Develop deeper understanding and the necessary tools to investigate the signaling mechanisms that guide cellular response to specific scaffold properties.

3. Disseminate new methods and technologies developed by RESBIO to the biomedical community and initiate an industrial network for innovation.

RESBIO

Integrated Technologies for Polymeric Biomaterials

A National Research Resource

HOW YOU CAN WORK WITH RESBIO

COLLABORATION. RESBIO seeks academic collaborators who can extend its core technologies to more areas of biomedical research. This occurs when collaborative projects are in synergy with RESBIO's core research capabilities. Selected projects receive collaborative resources from RESBIO but no direct financial support.

SERVICE. RESBIO's established methods and tools can be available on a service basis to biomedical researchers-both academic and industrial. Here, validated procedures using RESBIO's state-of-the-art equipment are performed for outside investigators.

TRAINING. Training in the core technologies available on an individual basis for selected scientists. Periodic workshops, some in partnership with advanced equipment vendors or other NIH-funded resource programs are a major training opportunity. All training activities are open to academic and industrial scientists .

DISSEMINATION. Publication of peer-reviewed articles, presentations at diverse conferences, and a web presence all contribute to disseminating RESBIO's research. The biennial New Jersey Symposium on Biomaterials Science brings RESBIO research together with the world on clinical applications and commercialization.

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Center for Dermal Research - CDR

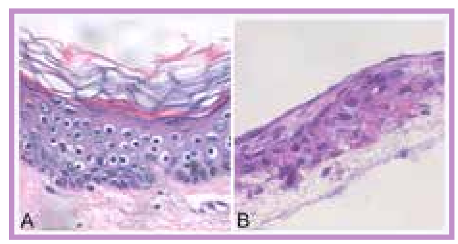
Our Vision is to be the premier dermatopharmaceutics research center in NJ conducting studies on topical and transdermal compound delivery, skin biology and skin tissue engineering. The CDR also provides quality educational opportunities for its members through workshops, seminar series, symposia and courses.

The Center for Dermal Research (CDR) aims to be the premier dermatopharmaceutics research center in New Jersey, conducting studies on topical and transdermal compound delivery, skin biology and skin tissue engineering. The CDR also provides quality educational opportunities for its members through technical workshops, seminar series, symposia and courses. The CDR offers pharmaceutical, personal care, cosmetic and other companies an opportunity to participate in diverse activities through formal membership.

1. We are interested in developing and formulating ultradeformable liposomal (UDL) systems that after topical application can permeate deep into the epidermis and dermis and effectively deliver their cargo (siRNA) to the resident cells. The advantage of our ultradeformable liposomes is that they are small in size and are flexible enough to squeeze themselves between skin stratum corneum cells and penetrate deep into the skin layers.

3. We are interested in fabricating polymeric scaffolds via electrospinning process to construct human skin equivalents. Electrospinning provides tunable scaffolds and allows the scaffolds to mimic extracellular matrix properties. These tissue-engineered human skin equivalents can potentially be utilized for in vitro irritation testing of topically applied drug compounds and formulations as well as potentially apply as skin grafts for wound healing.

2. We are designing novel approaches to treating acne by encapsulating drugs such as adapalene in tyrosine-derived nanospheres (carriers) placed in topically applied hydrogel formulations. The challenge is to have the drug release inside the hair shaft that has a highly lipophilic environment due to the sebum produced in this area.



Tissue- engineered human skin equivalents on bioactive polymeric scaffolds. Histology H&E images of (A) human cadaver skin and (B) human skin equivalents on bioactive polymeric scaffolds.

Research Interests

1. Optimization of topical, transdermal & transmucosal drug delivery; development of novel skin permeation models & computational modeling.
2. Design & evaluation of novel dermal penetration enhancers and retardants & their structure-activity relationships. Using enhancers for transdermal delivery of actives for the treatment of Alzheimer's disease, dementia, multiple sclerosis and other CNS disorders.
3. Design and testing of novel nanosphere and siRNA topical formulations for the treatment of acne and melanoma respectively.
4. Visualization of drug transport pathways in skin using Raman, Fourier Transform Infra-Red spectroscopy, electron and confocal microscopy.
5. Development of novel human tissue cultured skin equivalents for permeability testing.
6. Computational approaches to predicting skin transport of drugs.
7. Design & evaluation of orodisperible polymer films for drug delivery.
8. Designing new approaches to dissolution testing of novel dosage forms.

Center for Dermal Research

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Armed Forces Institute of Regenerative Medicine (AFIRM) Rutgers - Cleveland Clinic Consortium

The Rutgers-Cleveland Clinic Consortium (RCCC) is part of the Armed Forces Institute of Regenerative Medicine (AFIRM), a multi-institutional, interdisciplinary network working to develop advanced treatment options for our severely wounded servicemen and women. AFIRM is managed and funded through the US Army Medical Research and Materiel Command (MRMC); with additional funding from the US Navy, Office of Naval Research, the US Air Force, Office of the Surgeon General, the National Institutes of Health, the Veterans Administration, and local public and private matching funding.

AFIRM's mission is to develop new products and therapies to treat severe injuries suffered by US service members in the current wars. The AFIRM teams, working in research laboratories and clinics across the country, are advancing biological therapies (including adult stem cells and growth factors), tissue and biomaterials engineering, and advanced transplantation methods. These new treatments will enable the body to repair, replace, restore and regenerate damaged tissues and organs.

The RCCC consisted of 25 research teams that developed promising biomaterials, cell-based and combined regenerative medicine technologies that will someday become new commercial products to restore lost tissue and function. In an effort to advance the commercialization of many of these products, the RCCC forged collaborations with nearly 20 industrial partners. The planned therapies will not only be available to the wounded warriors, but also civilian trauma and burn patients as well.

In addition to the cutting edge research and development programs, the RCCC-AFIRM manages five clinical trials, enabling therapies for some of the most difficult challenges military medicine faces in the care of severely injured warriors:

- Scar Remediation using Autologous Fat Transfer (University of Florida, and United States Army Institute of Surgical Research)
- Face Transplant for Extensive and Deep Injuries to the Face (Cleveland Clinic Foundation)
- Novel Immunosuppression for Kidney Transplants (Tolera Therapeutics, Inc.)
- Engineered Skin Substitutes for the Treatment of Deep Partial-and Full-Thickness Burn Wounds in Adult Patients (Lonza Walkersville, Inc.)
- Ex Vivo Produced Oral Mucosa Equivalent to Treat Large Intra-Oral Defects (University of Michigan)

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Postdoctoral Research Training

T32 - Translational Research in Regenerative Medicine

To deliver unique research experiences built around special combinations of expertise, this postdoctoral training program draws its faculty from six institutions. Each faculty member is a leading researcher in his or her own field. Many of them are currently collaborating, and all are eager to co-mentor new trainees in individualized research projects at the frontiers of regenerative medicine.

International Summer Exchange Program

The New Jersey Center for Biomaterials at Rutgers University hosts an annual international summer exchange program as part of the International College of Fellows - Biomaterials Science and Engineering (ICF-BSE). The purpose of the program is to create valuable training experiences in leading edge biomaterials research for advanced graduate students. These young scientists are drawn from the most prominent biomaterials research laboratories worldwide for a 3-month summer research experience. Unlike many traditional exchange programs, each international student will have a pre-arranged work plan, access to state-of-the-art equipment, and the mentorship of a senior faculty member to advance their research and form lasting collaborations.

The International Summer Exchange Program is open to international graduate students of ICF-BSE fellows doing research that requires facilities or expertise that are not available in their home countries. Since 2007, NJCBM has hosted students from Singapore, France, Brazil, Australia, India, Ireland, Poland, Taiwan, UK, Portugal, Chile, and Spain.

NJCBM Programs are funded by:

Rutgers - The State University of New Jersey; the National Institute of Biomedical Imaging and Bioengineering of the National Institutes of Health (NIH); the National Institute of Neurological Diseases and Stroke of the NIH; the US Army Medical Research and Materiel Command; the National Institute of Standards and Technology; REVA Medical, Inc.; Osteo Science Foundation, the Rutgers Class of 1954 , and the New Jersey Commission on Spinal Cord Research.

NJCBM Industrial Program Overview

From its inception in 1997, the New Jersey Center for Biomaterials has been designed through, and focused upon, industrial partnerships. Many of the world's leading biotechnology and pharmaceutical companies have their headquarters in New Jersey and many of these companies have over the years established collaborations with the Center. Today these local companies and others across the nation and around the globe, ranging in size from brand new start-ups to major multi-national corporations, are part of our integrated networks for biomedical innovation. We are working on a wide array of projects under customer service agreements, materials transfer agreements, and research project agreements, all providing confidentiality and protection of intellectual property rights. Some examples of our ongoing projects supporting our industrial sponsors' and collaborators' technologies are:

- Commercial-scale extrusion of biodegradable polyester fibers and their fabrication into kink-free, flexible braided nerve regeneration conduits (Figures 1 and 2);
- Sterilization protocol development for ultra-fast biodegrading biomaterial devices;
- Synthesis of high-strength biodegradable polycarbonates for cardiovascular stents (Figure 3);
- Formulation of polysaccharide-based hydrogels providing controlled release of antimicrobial agents;
- Scale-up of polyols to kilogram quantities for polyurethane-based tissue scaffolds;
- Tensile testing of the mechanical properties of biopolymer wound dressings;
- Polymeric surface modification for control of stem cell adhesion and quartz crystal microbalance characterization of surface protein adsorption

We have established licensing agreements with several companies based on novel, patented biomaterials and biomedical technologies developed at the Center. And, as the Center is an integral part of Rutgers, one of the nation's leading academic institutions, we have provided consulting and educational programs and hands-on programs for industrial scientists on such topics as polymeric medical devices and the interaction of stem cells with biomaterials. A key to our long track record of successful industrial projects and programs is our leadership team, which is comprised of entrepreneurs, innovators, and former senior corporate executives with over 100 years of combined industrial experience. We understand and can effectively address the needs of companies and the market forces that drive those needs, and we welcome companies of all sizes to work with us on projects that drive the development of new healthcare and personal care products.

Figure 1. Alex James melt extruder produces biodegradable fibers at up to 100 m/min

Figure 2. Flexible nerve conduit of braided biodegradable filament

Figure 3. Chemspeed Accelerator for 192 parallel syntheses

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NJCBM Collaborators

Linking to potential partners worldwide has become standard operating procedure for NJCBM. While the research and training programs have extensive lists of formal collaborators, less formal connections are maintained through the International College of Fellows of the merged biomaterials societies of 10 nations/regions that span the globe.

Corporate Collaborators

Adaptive ACT Solutions Corp
AkzoNobel
Ashland
Ateriocyte
ATEX
ATRM Advanced Technologies and Regenerative Medicine, LLC
AVON
BARD
BASF
BCT
Biolin Scientifics
BioTime
Biomedical Structures
Biomomentum
Celgene
Chrono Therapeutics
Colgate
CRODA
Cyalume Specialty Products
DermaNest
DPP DermPathe Pharmaceuticals
Fox Rothschild LLP
Galderma
GSK Glaxo Smith Kline
Image IQ
Ingredion
Intertek
Isotechnika
Johnson & Johnson
Lonza
LuxBio Sciences
Merck
Merial
Nanoink Inc
Paradigm Science Inc
Reva Biomedical
Society For Biomaterials
Stryker
Target Health
Terumo
Teva Pharmaceuticals
TRI Princeton
Xerox

Academic Collaborators

Bioengineering Research Partnership
Boston University
Carnegie Mellon
Case Western Reserve
Clemson University
Cleveland Clinic
Cooper Health
Dartmouth
Mass General Hospital
Mayo Clinic
MIT
New Jersey Commission on Spinal Cord Research
NIST National Institute of Standards and Technology
NJIT
Philadelphia University
Princeton University
RUNEG - Rutgers University Neuro-Engineering Group
The University of Akron
University of Cincinnati
University of Florida
University of Illinois
University of Michigan
University of Minnesota
University of Pennsylvania
UNY- Stoneybrook
Vanderbilt

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• *Advancement of New Technologies toward Commercialization* •

• *Fostering Entrepreneurship* •

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