BIOMATERIALS AND BIOENGINEERING PROGRAM AT N.C. A&T

NATIONAL SCIENCE FOUNDATION UPDATES PRIORITIES

BIOMATERIALS FORUM

OFFICIAL NEWSLETTER OF THE SOCIETY FOR BIOMATERIALS

FIRST QUARTER 2025 • VOLUME 47, ISSUE 1

ALSO INSIDE

AIMBE ANNUAL EVENT RECAP

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BIOMATERIALS FORUM

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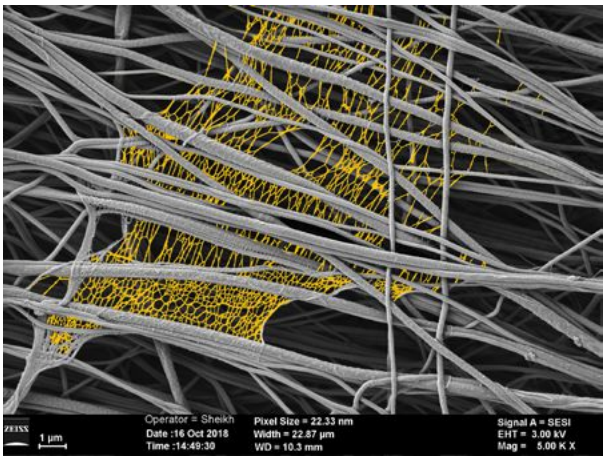
If interested in filling a vacancy above, please reach out to your SIG Chair.
Contact information can be found on individual SIG pages as found **here**.



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ON THE COVER

Spider web--like nanonet-nanofiber scaffolds composed of polycaprolactone (PCL), chitosan, and Diclofenac, a non-steroidal anti-inflammatory drug, were developed in the lab using electrospinning technology. These hybrid fibrous scaffolds are designed to closely mimic the architecture of natural extracellular matrices (ECM), offering a highly porous, interconnected structure that supports cell attachment, proliferation and nutrient diffusion. The incorporation of Diclofenac provides anti-inflammatory properties, making these scaffolds particularly suitable for tissue engineering applications where inflammation control is critical.

From the Editor

By Roger Narayan, MD, PhD, Biomaterials Forum Executive Editor

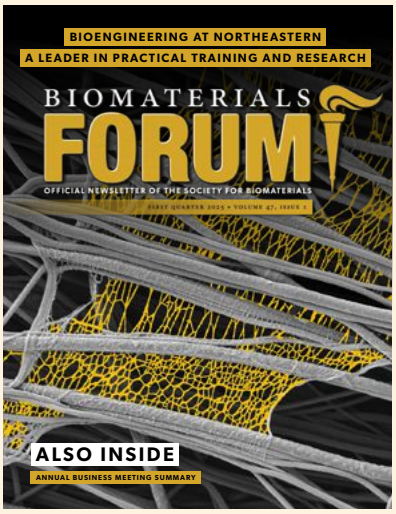
Welcome to the First Quarter issue of the Biomaterials Forum! Sarah Stabenfeldt provides an overview of the 2025 Annual Meeting in her President's Letter. The AIMBE update includes details on the Annual Event and Hill Day, which took place earlier this spring, and provides information about an upcoming AIMBE regional event, which will take place at the University of Illinois Chicago. The update also contains links to several online resources that can be used by researchers to engage with policymakers and other community leaders about their support of medical and biological engineering research activities.

Our feature article this issue highlights the history of biomaterials and bioengineering research at North Carolina Agricultural & Technical State University. The university's wide-ranging biomaterials research activities include the development of magnesium-based implants that can degrade inside the body. Current biomaterials-focused efforts, including the Piedmont Triad Regenerative Medicine Engine (Regen Medicine Engine), the Center for Neurovascular Engineering Research and adVanced Education (NERVE), and the Fostering Innovation Through Biosystems for Enhanced Scientific Technologies (FITBEST) Laboratory, are also considered.

Industry News updates us on tissue engineering trends, including the growth of market segments associated with orthopedics, musculoskeletal, spine, cardiology and vascular applications. The Government News provides timely information on National Science Foundation priorities and a policy shift by the U.S. Food and Drug Administration to phase out animal testing requirements for the development of monoclonal antibody therapies and other types of drugs.

Please feel free to contact me at roger_narayan@ncsu.edu if your group would like to share biomaterials research, education and translation efforts that may be of interest to the Society For Biomaterials community. The submission of news items, updates, and cover images is always welcome.

CALL FOR COVER ART



WE WANT TO FEATURE YOUR EXCITING BIOMATERIALS ARTWORK ON THE COVER OF *BIOMATERIALS FORUM!*

Deadline: Accepted on a rolling basis.

Instructions: Please email artwork (digital images, artistic creations, etc.) to info@biomaterials.org, to the attention of the Executive Editor of the *Biomaterials Forum*. All artwork with biomaterials relevance that have not appeared as a *Forum* cover are welcome. Multiple submissions are permissible.

Description: Selected artwork will appear as the cover of a future issue of *Biomaterials Forum* along with a brief "On the Cover" description of the subject and name/affiliation of the creator.

Format: High-resolution electronic version in .gif, .tiff or .jpeg file format.

From the President

By Sarah Stabenfeldt, SFB President

Dear Members,

What an incredible gathering we had at the 2025 Annual SFB Meeting in Chicago! Thank you to everyone who participated, presented, volunteered and contributed to the energy and excellence that made this 50th anniversary celebration such a memorable success. From cutting-edge science to meaningful conversations and new collaborations, the meeting truly reflected the heart of our society: innovation, community and shared purpose.

Our theme — "Half a Century of Progress: Crafting Resilience in Mind & Matter" — resonated throughout the meeting. It reminded us that the progress we celebrate is grounded not just in scientific achievement, but in the resilience, mentorship and collaboration that have always defined SFB. This meeting was a testament to the strength of our community and a powerful reminder of what we can accomplish together.

As we look ahead, let's carry the momentum forward. The connections we make at the annual meeting are just the beginning. I encourage each of you to continue engaging with the Society — whether through special interest groups, mentorship opportunities, educational initiatives or planning for next year's meeting. Your involvement helps shape the future of biomaterials science and ensures that SFB continues to thrive as a space for learning, leadership and inclusivity.

Thank you for being part of this community. I'm excited for all that lies ahead — and I look forward to seeing you again soon as we build on our shared mission together.

All the best,

Sarah E. Stabenfeldt, PhD
Professor of Biomedical Engineering, Arizona State University
President of Society For Biomaterials

CALLING ALL BOOKWORMS!

If you'd like to contribute a review of your recent favorite read to the ***Biomaterials Forum***, send it for consideration to the Editor at ***Roger_narayan@ncsu.edu***. If it's approved, it will be published in a future Forum Book Review column!

AIMBE Updates

2025 AIMBE ANNUAL EVENT

AIMBE held its latest Annual Event on March 29–31, 2025, in Washington, D.C. The meeting brought together AIMBE Fellows and other stakeholders to address challenges facing the medical and biological engineering community. The event featured keynote addresses, and technical and policy panel discussions.

This year's annual event also featured AIMBE's largest-ever Hill Day, during which more than 100 Fellows conducted more than 120 meetings with lawmakers to advocate for biomedical research funding and policy support. AIMBE also welcomed 163 new Fellows into its College of Fellows and introduced the inaugural cohort of its Emerging Leaders Program, aimed at empowering mid-career professionals in the field.

Notable recognition included the Pierre Galletti Award presented to Dr. Jennifer West for her contributions to biomaterials and nanomedicine, as well as Professional Impact Awards honoring Dr. Susan S. Margulies (Leadership), Dr. Andre L. Churchwell (Diversity, Equity and Inclusion), Dr. Weibo Cai (Mentoring) and Dr. Maria Oden (Education). A full recap of the meeting can be found here.

AIMBE ADVOCACY RESOURCES

AIMBE offers a comprehensive suite of advocacy resources to support researchers in engaging with policymakers and promoting the advancement of medical and biological engineering. These resources include tools for contacting Members of Congress, such as customizable letter templates and guidance on scheduling meetings or phone calls with lawmakers. Additionally, AIMBE provides up-to-date fact sheets on federal agencies including the NIH and NSF, as well as talking points to aid in effective communication with legislators. To access these tools and learn more about how to get involved, visit the AIMBE Advocacy Toolkit and see below for helpful resources from AIMBE

- 2025 AIMBE Congressional Visits: Talking Points
- AIMBE Updated NIH Fact Sheet
- AIMBE Updated NSF Fact Sheet
- Share Your Grant Disruptions
- State Fact Sheets: NIH in Your State (United for Medical Research)
- State Fact Sheets: NSF in Your State (NSF)

AIMBE TO HOST REGIONAL EVENT IN CHICAGO

In an effort to support Fellows locally and provide more opportunities for advocacy and networking, AIMBE is hosting a series of regional events. The next AIMBE regional event is taking place on May 30, 2025, 3–6 PM CDT in Chicago, Illinois. This event is being hosted in conjunction with the University of Illinois Chicago (UIC) and will take place on its campus. This will be a timely opportunity to help district policymakers learn more about the meaningful research and biotechnology innovations conducted by their constituents.

Given the current political climate, researchers will also be able to highlight the impact of grant disruptions on the scientific enterprise and economic consequences on a local level. The event includes medical/technology demonstrations by AIMBE Fellows followed by a networking reception. For more information on this event, please contact outreach@aimbe.org.

ATTENTION MEMBERS!

WE WOULD LOVE TO HEAR FROM YOU.

IF YOU HAVE NEWS TO SHARE WITH FORUM READERS, LET US KNOW. EMAIL YOUR NEWS AND ANY PHOTOS TO INFO@BIOMATERIALS.ORG AND YOU COULD BE FEATURED IN THE NEXT ISSUE.

The Biomaterials and Bioengineering Program at North Carolina A&T

THE BIOMATERIALS AND BIOENGINEERING PROGRAM AT NORTH CAROLINA A&T

North Carolina Agricultural and Technical State University's (N.C. A&T) research in biomaterials and biomedical engineering focuses on applying engineering principles to address medical and biological challenges, with a strong emphasis on achieving practical and impactful outcomes. A cornerstone of this work is the Engineering Research Center (ERC) for Revolutionizing Metallic Biomaterials (RMB), funded by the National Science Foundation (NSF) with a $36.7 million grant.

Launched in 2008, the ERC serves as the lead institution in this collaborative effort with the University of Pittsburgh, the University of Cincinnati and Hannover Medical School in Germany. ERC-RMB successfully developed biodegradable metals based on the premise that new kinds of implants can adapt to the human body and eventually dissolve when no longer needed, thereby eliminating the need for multiple surgeries and reducing healthcare costs.

This magnesium-based biodegradable metals system offers significant therapeutic advantages over implants used today. Breakthrough activities include development, processing and testing of novel degradable alloy systems; new and improved versions of existing clinical-use plates, screws and stents; innovative nanocoating technologies to yield special surface functionalities; and methods to control implant corrosion, biocompatibility and improved bone growth. ERC-RMB is working to transform the current medical and surgical treatments into areas of craniofacial, dental, orthopedic, cardiovascular, thoracic and neural interventions.

The ERC-RMB's intellectual merit impacted various materials processing/characterization (chemical, physical, mechanical), modeling, and, finally, biocompatibility testing. One of the missions in ERC-RMB was to establish the first Bioengineering Program at HBCUs, and an ABET-accredited, standalone, first HBCU Biomedical Engineering BS and MS program in the nation was established in 2010–11. The program has profoundly influenced many underrepresented students and significantly increased diverse student populations to conduct transformative research.

The university's Department of Chemical, Biological, and Bioengineering drives much of this research, exploring areas including biomaterials, biomechanics, tissue engineering and bioimaging. Faculty and students collaborate on projects involving biosystems analysis, implantable medical devices, artificial organs and biosensors, often integrating interdisciplinary approaches from chemistry, physics and life sciences.

N.C. A&T's research extends to other biomedical engineering domains, including nanostructured biomaterials and regenerative medicine. The university's high-research activity classification underscores its role in pushing the boundaries of these fields, contributing to both academic knowledge and practical applications in healthcare.

HISTORY OF THE BIOENGINEERING PROGRAM

The Master of Science (MS) in bioengineering program welcomed its first students in 2010, followed by the Bachelor of Science (BS) in bioengineering in 2011. The BS program was designed to train students in applying engineering to healthcare, covering areas includinglike prosthetics, medical imaging and tissue regeneration. The MS program, a two-year graduate track, emphasizes advanced research in two specialization areas: biomaterials and biomechanics; and bioimaging, biosignals and biosensors. It prepares students for PhD studies or careers in industry, government or consulting, offering thesis, project and course-only options. The program achieved a historic milestone in 2016 when it became the first HBCU bioengineering program to earn accreditation from the Accreditation Board for Engineering and Technology (ABET), retroactive to October 2013. This accreditation followed the graduation of its first BS cohort and an ABET review in the 2015-16 academic year, cementing N.C. A&T's leadership among HBCUs in this field.

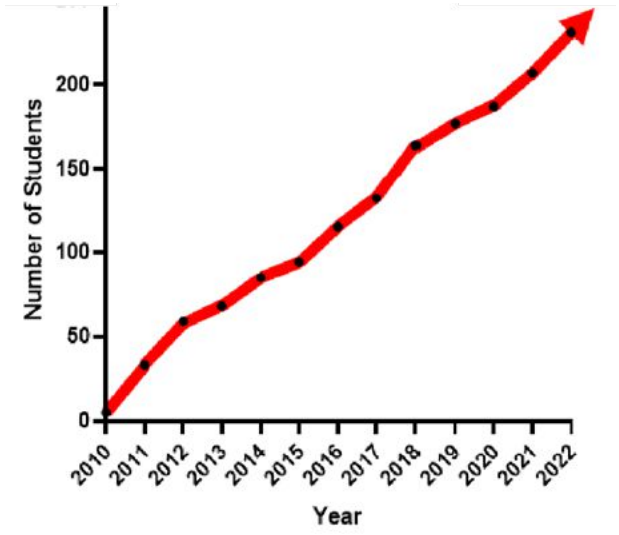


Figure 1. Growth of the Bioengineering BS/MS Program at N.C. A&T: Enrollment shows the increase of the Bioengineering Program.

The Biomaterials and Bioengineering Program at North Carolina A&T (Continued)

Since its launch, the bioengineering program has grown steadily, supported by N.C. A&T's College of Engineering, which ranks high in research funding within the UNC System. Today, it continues to evolve, reflecting N.C. A&T's broader mission to lead in STEM education and research while addressing societal needs through engineering excellence. The programs have grown rapidly, now enrolling approximately 200 students as the BS/MS program enrollment continues to expand (Figure 1),

Moving Forward: PhD Bioengineering Program: N.C. A&T is in the process of establishing the first HBCU standalone Bioengineering PhD program (expected to start in the fall of 2026). With the great success of the BS/MS Bioengineering Programs over the past 15 years, we are well-ready to build the first Bioengineering PhD Program at HBCUs. This will be a hub to bring talented students from various backgrounds to address unmet clinical needs through materials, AI tech, stem cell and medical device innovation.

New Bioengineering Research and Training Facilities at N.C. A&T: With recent institutional investment from the University, bioengineering labs are now housed in the Harold L. Martin Sr. Engineering Research & Innovation Complex (Figure 2), covering an impressive 9,000 square-feet. This state-of-the-art facility provides critical infrastructure to accomplish our research and educational missions for bioengineering. The new research building will serve as a central hub for research and education for the PhD in bioengineering.

Figure 2. Harold L Martin Sr. Engineering Research & Innovation Complex housing the biomaterials and biomanufacturing research programs

N.C. A&T JOINS PIEDMONT TRIAD REGEN MEDICINE ENGINE

The National Science Foundation (NSF) has awarded a 10-year, up to $160 million grant to establish the Piedmont Triad Regenerative Medicine Engine (Regen Medicine Engine) – one of 10 inaugural NSF Regional Innovation Engines across the nation. This investment is one of the largest across federal agencies to date and the effort, led by the Wake Forest University (WFU) School of Medicine, is in collaboration with a core team from N.C A&T, Winston-Salem State University, Forsyth Technical Community College and industry partners ReMDO and Axiom Space.

The Regen Medicine Engine team describes regenerative medicine's goal as a means to "replace or restore function to tissues and organs compromised by injury or disease" through interdisciplinary expertise. N.C. A&T's Regen Medicine Engine is led by A&T's University Distinguished Professor and associate dean of Research and Innovation, Salil Desai, PhD. A&T's leadership of the biomaterials and biomanufacturing core of the Piedmont Triad Regenerative Medicine Engine will give students hands-on experience that will develop the next-generation workforce providing novel therapies for human well-being. The core team will establish Innovation, Translation and Education Cores that focus on biomaterials and bioengineering – developing biomaterials as cell scaffolds for regen products. A&T's team comprises more than 10 faculty, six research staff and 15 graduate and undergraduate students across the entire campus.

Desai is working with A&T staff and faculty members Del Ruff, executive director of Employee Engagement and Success; Sanjiv Sarin, PhD, special assistant to the chancellor and industrial systems engineering professor; bioengineering professors Narayan Bhattarai, PhD, and Yeohung Yun, PhD, and associate professor Mohammad Azad, PhD; associate chemistry professor Bishnu Bastakoti, PhD; Geleana Alston, PhD, associate dean of Research and Community Engagement, College of Education; and associate nanoengineering professor Kristen Dellinger, PhD. This interdisciplinary team represents the university's long-standing capabilities in convening leading experts to conduct groundbreaking research that has practical applications in bio- and agro-environmental systems manufacturing clusters.

Regen Medicine Engine's capacity to become a self-sustaining regional project to provide an innovation ecosystem to stimulate workforce development, job creation and economic growth through the development of technologies that benefit the emerging regenerative medicine industry. More than 80 partners have committed to supporting this ecosystem, which includes local businesses, nonprofits and government agencies.

The Biomaterials and Bioengineering Program at North Carolina A&T (Continued)

Figure 3. N.C. A&T's Biomaterials and Biomanufacturing Team

State of Art Interdisciplinary Bioengineering Center (IBEC): In alignment with the Research 1 (R1) goal and the Preeminence 2030 objectives, N.C. A&T has committed a $5 million investment to establish the Interdisciplinary Bioengineering Center (IBEC) on the first floor of the new ERIC building. Expected to open in mid-2025, IBEC will play a pivotal role in advancing bioengineering research and education for the new Bioengineering PhD program. Preparation will be made for BSL-2 operation with small-animal testing facilities, space renovation, equipment installation and training, networking with local hospitals and industries and student exposure.

NERVE Center: N.C. A&T was awarded the Center for Neurovascular Engineering Research and adVanced Education (NERVE) from the National Institute of Biomedical Imaging and Bioengineering (NIBIB). Led by Dr. Yeoheung Yun, professor of bioengineering, this is a $7 million award over a seven-year period. The NERVE center serves as a sustainable hub to transform the neural materials research activities and technology development of brain science and to prompt the engagement of the next-generation bioengineering workforce (Figure 4). The center will target clinically important brain diseases, such as Alzheimer's disease, and will develop and advance cutting-edge technology, including the integration of nanodevices for vascularized organoids, small-animal testing capacity, advanced imaging and machine learning applications. The award will also support the establishment of a standalone bioengineering PhD program — the first such degree program at an HBCU in the country.

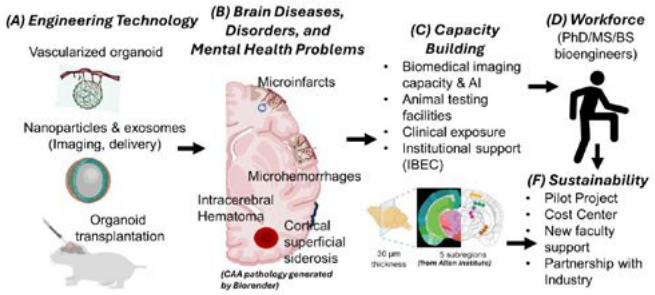


Figure 4. Overall landscape of the NERVE; (A) Engineering Technology (B) Brain diseases/disorders and mental health problem to address, (C) Bioengineering capacity building, (D) Workforce development, and (F) Sustainability.

Fostering Innovation Through Biosystems for Enhanced Scientific Technologies (FITBEST) Laboratory: The FITBEST Lab is dedicated to advancing the development of in vitro material-directed brain models that closely mimic the structural, mechanical and functional complexities of the human brain. Leveraging a multidisciplinary approach, the lab integrates mechanically tunable extracellular matrix (ECM) materials, induced pluripotent stem cell (iPSC) differentiation, brain organoids, tissue chips and bioprinting technologies to simulate brain activity, mechanical microenvironments and complex physiopathological responses.

A particular area of innovation is the integration of organoid intelligence systems, where biologically inspired models are coupled with computational tools for deeper insights into brain function. To interpret the bidirectional communication between organoids and vascular structures, the FITBEST Lab is actively developing AI models that analyze dynamic signaling and functional connectivity. As part of efforts to recapitulate the intricate ECM composition of the brain, the lab designs and synthesizes a variety of hydrogels that direct organoid growth and promote region-specific maturation.

One notable achievement includes the development of vascularized cortical organoids derived from Alzheimer's disease (AD) patient-specific iPSCs. These organoids not only exhibit hallmark AD features – such as amyloid-beta accumulation and tau pathology – but also serve as powerful platforms for screening clinically relevant therapeutics. This approach brings the potential for personalized medicine and disease modeling closer to reality by bridging materials science, stem cell biology, and AI-driven analysis.

The Biomaterials and Bioengineering Program at North Carolina A&T (Continued)

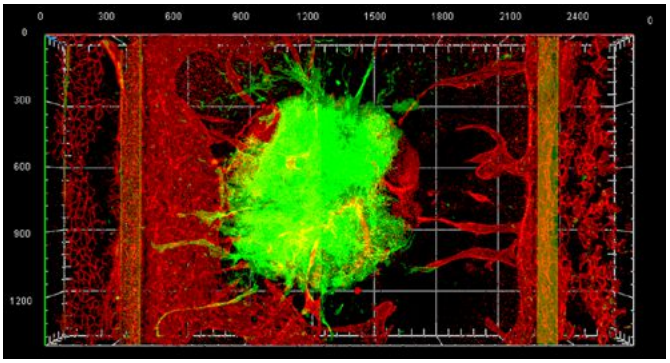


Figure 5. 3D confocal images of spheroid on vascular network (Red (CD31) is microvessel and green (beta III tubulin) is cortical spheroid),

Innovations in Smart and Functional Biomaterials: The Biomaterials Innovation Team, led by Dr. Narayan Bhattarai, is at the forefront of developing smart and functional biomaterials to address critical needs in regenerative medicine, drug delivery and biomedical device engineering. Grounded in interdisciplinary collaboration and translational-natured research, the team combines materials science, biomedical engineering and nanotechnology to create biomaterials with significant clinical potential and societal impact. At the core of the team's research is the design, synthesis and characterization of bioresorbable materials that promote tissue regeneration, enable sustained and targeted drug release, and serve as platforms for next-generation therapeutic strategies. The lab specializes in electrospinning, 3D printing, hydrogel engineering, nanoparticle functionalization and smart material integration, with a consistent focus on biocompatibility, scalability and customized performance for specific biomedical applications.

In parallel with cutting-edge research, Bhattarai remains deeply committed to education and workforce development. As a founding faculty member of the Biomedical Engineering program at NC A&T, he has played a pivotal role in curriculum design, program accreditation and inclusive student training. His lab provides robust mentorship to undergraduate and graduate students, many of whom have contributed to peer-reviewed publications, conference presentations and patented innovations in the field of biomaterials. Looking forward, the team is expanding its focus to include stimuli-responsive biomaterial systems, tissue-specific scaffold bio-fabrication and AI-driven design of custom biomaterials. These emerging areas promise to further enhance the precision, functionality and translational potential of the lab's innovations. By bridging fundamental materials science with real-world clinical needs, the Bhattarai Lab continues to push the boundaries of what biomaterials can achieve in modern healthcare.

Figure 6: Biomaterials research team members Alexis Moody (left, graduate student), Milani Needam (center, undergraduate researcher), and Dr. Narayan Bhattarai (right, faculty mentor) representing NC A&T at the 50th Annual Meeting of the Society for Biomaterials (SFB). Milani was the recipient of the 2025 SFB Cato Laurencin, MD, PhD Undergraduate Travel Fellowship.

Integrated Nano-Bio Manufacturing Laboratory: The Integrated Nano-Bio Manufacturing Cleanroom lab led by the Desai group supports research in the areas of smart cyber-physical systems, hybrid additive and nano- and bio-manufacturing. Their work bridges multiphysics modeling, regenerative tissue engineering and product design and realization, forming a cohesive platform for next-generation biomedical solutions.

A key focus of the lab lies in the biomanufacturing of tunable coatings for orthopedic implants and cardiovascular stents. These coatings, guided by nanoscale topographies mediated with biomolecules, are crucial for directing cellular behaviors such as differentiation and proliferation. In this context, the group employs molecular dynamics simulations and high-performance computing resources to investigate how embedding bone morphogenetic protein (BMP-2) growth factors within nanoscale surfaces can influence stem cell-based osteochondral tissue regeneration.

The lab's hybrid bioprinting research integrates micro-extrusion, direct-write inkjet and nanoimprint lithography techniques. This combination defines hierarchical nano/micro architectures tailored for tissue-engineering applications. The ability to deposit heterogeneous biostructures on-the-fly, both in terms of geometry and material composition, will create an effective method to building biomimetic functionally gradient topographies. Unlike conventional scaffold fabrication methods, which are limited to predetermined pattern designs with lower aspect ratio and require retooling of the entire setup for variations in topology, the Desai group's tissue engineering research enables precise placement of bio-media on custom-patterned surfaces. This capability represents a significant advancement toward producing adaptable, high-resolution tissue engineering scaffolds with enhanced biological performance.

The Biomaterials and Bioengineering Program at North Carolina A&T (Continued)

AI-Based Digital Twins in 3D Bioprinting with Cybersecurity Considerations: The Desai research group is also working on a real-time, noninvasive framework that integrates acoustic signal analysis with AI-based predictive modeling to monitor and assess the quality of 3D bioprinted constructs. Acoustic patterns corresponding to key events – optimal printing, nozzle clogging, ink starvation and unstable extrusion – are recorded to develop a robust classification system. The acoustic signals undergo denoising using Spectral Subtraction and Harmonic Percussive Source Separation (HPSS), followed by the extraction of relevant features.

These features feed into a suite of machine learning (ML) models, including shallow classifiers (e.g., Support Vector Machines, Random Forests and Multi-Layer Perceptron) and advanced deep learning architectures such as Convolutional Neural Networks (CNNs) and Recurrent Neural Networks (RNNs). This acoustic monitoring framework also contributes to the development of a Digital Twin (DT) for bioprinting systems, enabling predictive simulation, anomaly detection and process optimization.

Furthermore, cybersecurity is addressed through secure data transmission protocols and AI-driven intrusion detection mechanisms, ensuring the protection of sensitive bioprinting data and operational continuity. By integrating AI-based modeling, acoustic sensing and cybersecurity, this research lays the groundwork for autonomous, intelligent and secure 3D bioprinting systems tailored for tissue engineering and regenerative medicine.

Industry News

INDUSTRY ACTIVITY AND FINANCIAL UPDATES FROM LEADING COMPANIES

Several U.S.-based companies active in tissue regeneration and biomaterials reported or announced their Q1 2025 financial results and strategic updates, reflecting ongoing sector momentum.

The following companies, along with others including Zimmer Biomet, Medtronic and Organogenesis Holdings, are key players driving innovation and commercialization in the U.S. tissue engineering market.[1]

- Axogen, Inc., a leader in peripheral nerve repair, is set to report its Q1 2025 financial results on May 8, 2025, with management preparing to discuss investment and growth plans.[2]
- Sanara MedTech Inc., specializing in regenerative medicine and biomaterial-based therapies, will announce its Q1 2025 financials on May 14, 2025, indicating continued investor interest in this space.[3]

ADVANCES IN BIOMATERIALS AND THEIR ROLE IN TISSUE REGENERATION

Biomaterials remain central to tissue regeneration, with significant advancements reported in 2025. The global biomaterials market, valued at $189.5 billion in 2024, is projected to reach $409.4 billion by 2030, growing at a compound annual growth rate (CAGR) of 13.7 percent.[4] Biomaterials such as polymers, ceramics, metals and natural materials are increasingly integrated into regenerative medicine, wound healing and implantable devices.

Key drivers include the aging population, rising incidence of cardiovascular and orthopedic diseases and the demand for personalized medicine. Innovations in 3D printing and additive manufacturing have enhanced the customization of implants and scaffolds, improving patient outcomes. Nanotechnology integration and biodegradable biomaterials are also contributing to market growth, especially in plastic surgery and reconstructive procedures.[4]

SECTOR OUTLOOK AND RESEARCH FUNDING HIGHLIGHTS

The tissue engineering and biomaterials sectors in the U.S. are benefiting from increased research funding and clinical trials aimed at developing next-generation regenerative therapies. For instance, government and private funding are supporting projects like OPTO-BIOPRINTING, which uses light to control protein production within cells, potentially revolutionizing tissue engineering techniques.[5]

The rising prevalence of chronic diseases such as diabetes, cancer and musculoskeletal disorders, combined with the limitations of traditional organ transplantation, underscore the urgent need for tissue regeneration solutions. This demand is expected to sustain market growth and innovation throughout 2025 and beyond.[6]

In summary, the first quarter of 2025 in the U.S. tissue regeneration and biomaterials industry is marked by strong market growth driven by technological advancements, expanding applications in orthopedics and cardiology, active financial reporting from key companies and robust research funding fostering innovative therapies. These factors collectively position the U.S. as a leading hub for tissue engineering and regenerative medicine development.

U.S. TISSUE ENGINEERING MARKET GROWTH AND TRENDS IN Q1 2025

The U.S. tissue engineering market was valued at approximately $22.08 billion in early 2025 and is forecast to grow robustly to $69 billion by 2034, reflecting a CAGR of 13.5 percent.[7] This growth is driven by increasing investments and funding aimed at developing advanced tissue engineering products, alongside rising demand for regenerative medicine solutions to treat chronic diseases and trauma-related injuries.

Key market segments include orthopedics, musculoskeletal and spine applications, which dominated with nearly 60 percent revenue share in 2024, while cardiology and vascular applications are expected to witness the fastest growth at a CAGR of 25 percent due to the rising prevalence of cardiovascular diseases and advancements in stem cell therapies.[6]

The market's expansion is supported by technological innovations such as gene editing, stem cell research, 3D bioprinting and biomaterials development, which enable the creation of complex, functional tissues for clinical use and drug testing. For example, companies such as Organovo are advancing 3D-printed human tissues, including liver and kidney models, for therapeutic applications.[5]

REFERENCES:

1. https://www.grandviewresearch.com/industry-analysis/tissue-engineering-and-regeneration-industry
2. https://www.biospace.com/press-releases/axogen-inc-to-report-2025-first-quarter-financial-results-on-may-8-2025
3. https://www.nasdaq.com/articles/sanara-medtech-inc-report-q1-2025-financial-results-may-14-2025
4. https://www.globenewswire.com/news-release/2025/02/27/3033608/0/en/2025-Biomaterials-Global-Market-Overview-2021-2030-Collaborative-Research-and-Smart-Biomaterials-Drive-Industry-Growth.html
5. https://www.grandviewresearch.com/industry-analysis/tissue-engineering-and-regeneration-industry
6. https://www.globenewswire.com/news-release/2025/03/07/3038978/0/en/Tissue-Engineering-Market-Size-to-Hit-USD-56-2-Billion-by-2032-Driven-by-Technological-Advancements-in-Regenerative-Medicine.html
7. https://www.biospace.com/press-releases/u-s-tissue-engineering-market-size-to-hit-usd-69-00-billion-by-203

Government Policy Updates

NEWS FROM THE FEDERAL AGENCIES THAT AFFECT BIOMATERIALS RESEARCH AND PRACTICE

NSF ISSUES UPDATES ON ITS PRIORITIES

On April 18, 2025, the National Science Foundation (NSF) issued updated priorities in response to recent executive orders. According to the guidance, NSF remains committed to its mission of promoting the progress of science; advancing national health, prosperity and welfare; and securing national defense by investing in promising ideas and individuals across all science and engineering disciplines.

This resource includes several frequently asked questions to give the research community more information about how to handle arising issues and changes in response to executive orders. The FAQs are routinely updated and include specific responses to questions that arise primarily based on grant terminations. Importantly, NSF has clarified procedures regarding cost reimbursements and project reporting for awards have been terminated.

NSF LAUNCHES EXECUTIVE ORDER IMPLEMENTATION SITE

NSF has established a dedicated page to inform the research community about the implications of recent executive orders on its operations. This resource provides updated guidance for panelists, reviewers, proposers and awardees, addressing changes in proposal submissions, merit review processes and award management.

The page includes a comprehensive FAQ section covering topics such as advisory committee statuses, proposal revisions and compliance with new directives. It also allows stakeholders to submit questions through a provided webform, with responses to be compiled and shared as they become available. The page is regularly updated to reflect the latest information and guidance.

FDA ANNOUNCES PLAN TO PHASE OUT ANIMAL TESTING REQUIREMENT FOR MONOCLONAL ANTIBODIES AND OTHER DRUGS

On April 10, 2025, the U.S. Food and Drug Administration (FDA) announced a significant policy shift to phase out the requirement for animal testing in the development of monoclonal antibody therapies and other drugs. According to the initiative, it aims to enhance drug safety, expedite the evaluation process, reduce reliance on animal experimentation, lower research and development costs and ultimately decrease drug prices.

As part of this effort, the FDA released a complementary Roadmap to Reducing Animal Testing in Preclinical Safety Studies, outlining strategic steps and regulatory guidance to support the transition.

The agency plans to implement New Approach Methodologies (NAMs), which include AI-based computational models and laboratory-grown human organoids, to assess drug toxicity and efficacy. The FDA will begin encouraging the inclusion of NAMs data in investigational new drug applications immediately and will also consider real-world safety data from other countries with comparable regulatory standards.

The FDA also plans to launch a pilot program allowing selected developers to utilize non-animal testing strategies, with the insights gained informing future regulatory changes.

NIH ANNOUNCES CHANGES TO FEDERAL GRANT TERMS AND CONDITIONS ON CIVIL RIGHTS

On April 21, 2025, the National Institutes of Health (NIH) issued Notice NOT-OD-25-090, introducing a new civil rights term and condition applicable to all NIH grants, cooperative agreements and other transaction awards. This term applies to domestic recipients of new, renewal, supplement or continuation awards issued on or after this date. It mandates that domestic recipients certify they do not, and will not during the award term, operate programs that advance or promote diversity, equity and inclusion (DEI); diversity, equity, inclusion and accessibility (DEIA); or discriminatory equity ideology in violation of federal anti-discrimination laws.

Additionally, recipients must not engage in discriminatory prohibited boycotts, specifically those targeting Israeli companies or entities doing business with Israel. Noncompliance may result in termination of the award and recovery of funds. This policy does not apply to foreign and international organizations.

NIH ANNOUNCES ENHANCED SECURITY MEASURES FOR NIH CONTROLLED-ACCESS DATA

Effective April 4, 2025, NIH will prohibit access to NIH Controlled-Access Data Repositories and associated data by institutions located in particular countries, noted as countries of concern. Institutions located in China (including Hong Kong and Macau), Russia, Iran, North Korea, Cuba and Venezuela are prohibited from accessing these repositories and associated data. This policy aligns with Executive Order 14117 and 28 CFR Part 202, aiming to safeguard the confidentiality, integrity and availability of participant data within NIH repositories.

NIH LAUNCHES POLICY IMPLEMENTATION REPOSITORY

NIH has created a centralized webpage to communicate recent and upcoming changes to its grant policies and processes in response to recent executive orders. These updates include revisions to application forms, peer review criteria and certain reporting requirements. The page also provides links to guidance and timelines to help the research community prepare for policy transitions and changing requirements.

REFERENCES:

1. https://www.nsf.gov/updates-on-priorities?sf221920080=1&sf221920091=1
2. https://www.nsf.gov/executive-orders
3. https://www.fda.gov/news-events/press-announcements/fda-announces-plan-phase-out-animal-testing-requirement-monoclonal-antibodies-and-other-drugs
4. https://www.fda.gov/media/186092/download?attachment
5. https://grants.nih.gov/grants/guide/notice-files/NOT-OD-25-090.html
6. https://grants.nih.gov/grants/guide/notice-files/NOT-OD-25-083.html
7. https://grants.nih.gov/policy-and-compliance/implementation-of-new-initiatives-and-policies

2026 ANNUAL MEETING & EXPOSITION

CALL FOR *IDEAS*

ATLANTA, GEORGIA • MARCH 25-28, 2026

We want to hear from ***YOU***

Next year's most important meeting is taking shape now, and we need your input.

Here is your chance to help our members explore new and emerging fields of biomaterials research, including:

- breakthroughs in biomaterials science
- translation of basic research to clinical application
- next generation medical devices
- content that explores standards development
- regulatory issues and commercial realities
- the latest developments you see on the horizon

A two-stage proposal process will be used to select session topics for the 2026 meeting:

1. Submit your idea below.
2. Submissions that align with the Annual Meeting program objectives will be invited to submit full proposals.

Full proposals will be due in early August.

SUBMIT YOUR IDEA HERE!

Special Interest Groups are encouraged to submit ideas jointly with other SIGs or with industry partners for broad appeal.

Session Organizers: Abstracts submitted to your own session(s) have a higher chance of acceptance

PLEASE SUBMIT YOUR IDEA TODAY

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