CSET Good News Report
April 2026

1. Center for Materials Research

- **Dr. Messaoud Bahoura,** Professor of Engineering and Director of the Center for Materials Research, and **Dr. Tanya David,** Assistant Professor of Chemistry**,** led a team of nearly two dozen volunteers in delivering engaging, hands-on STEM activities for children and families at the Children's Museum of Virginia in Portsmouth on April 4, 2026. The event created an interactive learning environment where young participants explored science through fun, accessible experiments that sparked curiosity and excitement about how the world works at the smallest scales.This outreach effort builds on the legacy of the NSF-funded Nanoscale Informal Science Education Network (NISE) through NanoDays, with a strong focus on inspiring the next generation—especially K–12 students—to develop an early interest in science, engineering, and technology. By bringing university researchers, undergraduate and graduate students, faculty, and educators directly into the community, the program makes cutting-edge science approachable and meaningful for children.

  NanoDays fosters public awareness and understanding of nanoscale science while encouraging young learners to imagine themselves as future scientists and engineers. Through these activities, children and families experience firsthand how materials can behave in surprising ways and how emerging technologies can shape the future, creating memorable moments that connect science with everyday life.


Exploring Tools—
Transmission
Electron
Microscopes


JUST A
BOY


The Perfect Elements
THEY
BECAUS

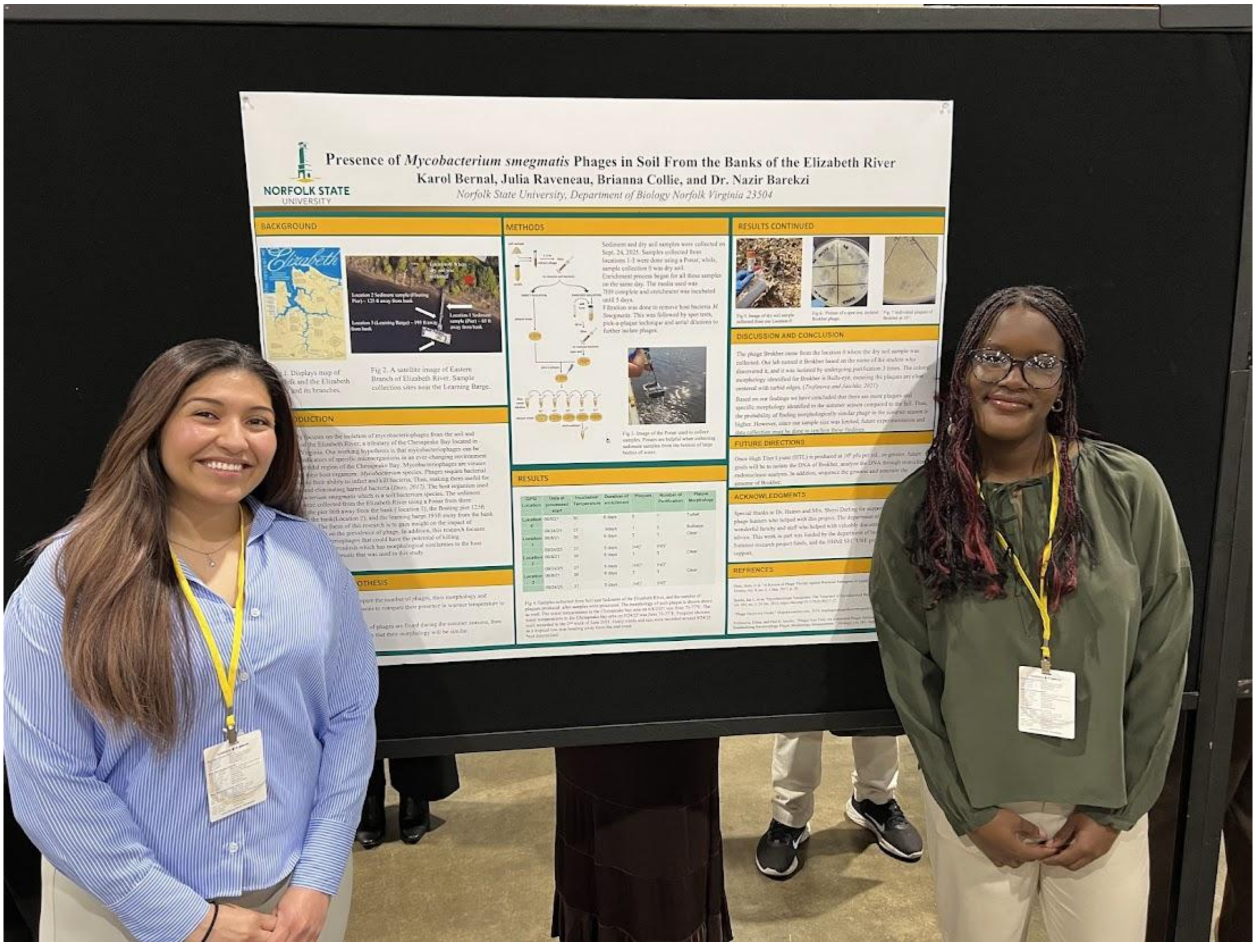

NanoDays
Exploring Tools—Transmission Electron Microscopes
WATER

Dr. Messaoud Bahoura, Professor of Engineering and Director of the Center for Materials Research, has submitted a research manuscript to Scientific Reports titled:"Semi-Solid-State Electrochromic Devices Based on Poly(3-hexylthiophene) Thin Films and Commercial UV-Curable Resins for Low-Power Applications."This work presents a novel approach to developing low-power electrochromic devices using polymer thin films integrated with UV-curable gel electrolytes. The devices demonstrate fast switching (~60 ms), high optical modulation (>30%), and stable, reversible performance under low voltage (±2 V). The study highlights a scalable and cost-effective pathway toward next-generation smart windows and display technologies using commercially available materials.

Dr. Messaoud Bahoura, Professor of Engineering and Director of the Center for Materials Research, played a prominent leadership role at the Biomedical Innovation and Integrated Health Systems (BIIHS) 2026 Conference, organized by NanoBioTech and held on April 30, 2026, at the Ted Constant Convocation Center.
Dr. Bahoura served as a member of the Scientific Organizing Committee, Session Chair for Biofabrication & Systems: Integrated Bioengineering Systems and Applications, and Chair of a poster session. In these roles, he contributed to shaping the conference program, facilitating high-impact discussions, and supporting the evaluation and recognition of emerging research.
The BIIHS 2026 Conference brought together leading experts, industry partners, and students to explore cutting-edge advances in diagnostics, therapeutics, biomaterials, nanotechnology, environmental health, and computational research. Dr. Bahoura's leadership underscores his continued commitment to advancing interdisciplinary research and fostering innovation in biomedical and integrated health systems.

2. Department of Biology

Dr. Nazir Barekzi, Norfolk State University Biology Department served as mentor to two fabulous undergraduate students, Mrs. Karol Bernal and Ms. Julia Raveneau who continued in the tradition of scholarship and excellence by presenting research at the 2026 National Conference on Undergraduate Research (NCUR) in Richmond, VA, held on April 13-15, 2026.



In addition, **Dr. Barekzi** mentored 28 students who presented a total of 12 posters at the 2026 Research and Innovation Symposium and Exhibition (RISE) Symposium on April 23, 2026 through the SEC^{3}URE: Spartans Engaged in Community-focused, Collaborative, Course-based Undergraduate Research Experience program in the Department of Biology (student poster presented by Emerald Hood and Brevin Caldwell is shown here).

Aylin Marz, Ph.D., Associate Professor of Biology, served as a Scientific Committee Member for the **NanoBioTech BIOINNOVATE 2026** conference held on April 30th at the Ted Constant Convocation Center, Old Dominion University in Norfolk. In addition, Dr. Marz chaired a **Biofabrication and Systems** focused oral session of the conference. Students Norfolk State University - **Cameron Moody (Biology), Ayodeji Aderin (Engineering), Olivia Pemrose (CMR/NASA)** - presented their research at the poster sessions. **Dr. Messaoud Bahoura** - Professor of Engineering and the Director of the Center for Materials Research - also acted as an organizer and session chair. This interdisciplinary conference aims to facilitate collaborations, spark innovation, and build networks amongst researchers in the nanosphere across all disciplines aimed towards bioinnovation. The advent of bionanotechnology has opened up innumerable opportunities for technological improvements at the interface of nanotechnology, biological, and medical applications. It will require interdisciplinary collaborations to overcome the hurdles in making these technologies readily available. This conference highlights the advancements in bionanotechnology made by researchers in both industry and academia, in addition to the materials and computational research that make these technologies possible.
Weblink: [NanoBioTech 2026 - Old Dominion University]

Ashley N. Haines, Ph.D., professor and chair, Department of Biology, and Richard E. Martin, Director of Energy & Sustainability, Facilities Management, appeared as guests on WTKR's *Coast Live* to discuss on-campus initiatives and a progressive curriculum to making our planet greener. See their guest appearance [here].

3. Department of Engineering

Ayodeji Aderin, MS.EEN, Department of Engineering, presented a paper titled, *Microfluidic device for label-free cell deformation analysis,* HBCU Chips Network Annual Conference, April 1-2, 2026 in Atlanta, GA. *Co-authors:* Aylin Marz, Messaoud Bahoura, Patricia Mead, and Yaw Sefa-Boateng

Breast cancer outcomes are closely linked to the stage at which the disease is first detected. To make early detection more accessible, a device capable of distinguishing between low- and high-HER2 breast cancer using optical tweezing has been proposed. Initial efforts using the optical trapping of SKBR3 cells have been fully manual, limiting precision, reproducibility, and throughput. This effort has produced a fully automated capability, allowing users to adjust experimental parameters, including laser power, image capture, and cell delivery parameters. Automated control of the operation parameters for a microfluidic controller, microscope camera, and laser diode driver has been fabricated at the Norfolk State University Micron-NSU Nanofabrication cleanroom facility. The system synchronizes device operation, enabling consistent cell manipulation and deformation. The functional prototype can regulate microchannel flow velocity via microfluidic pressure control, trapping and deforming cells by modulating the current output for laser diode drivers and capturing and storing micrographs at user-prescribed intervals. The prototype was developed in compliance with biomedical device safety standards (IEC/IEEE 82079-1:2019, IEC 62304, IEC 60601-1) ensuring operational safety. This automated optical tweezing system enhances the process of cell trapping and deformation assays, representing a step toward developing a clinically relevant diagnostic tool for breast cancer detection.

Sandra Eddie, MS.EEN, Department of Engineering, presented, In-Depth Analysis of How Various Parameters of Immersive VR-Based Training Influence Performance, at the HBCU Chips Network Annual Conference, April 1-2, 2026 in Atlanta, GA. **Co-authors:** Dickson Afful and Michael Kozhevnikov.

Virtual Reality (VR) has emerged as a powerful tool for training in high-risk and resource-intensive fields such as semiconductor manufacturing, where traditional hands-on learning is often limited by safety, cost, and facility access constraints. This study presents the development and in-depth evaluation of a Photolithography-focused Virtual Training Environment (PL-VTE) designed to support skill acquisition in one of the most precision-critical semiconductor fabrication processes. The research investigated how variations in some major VR design parameters influence trainee performance, procedural accuracy, knowledge retention, and perceived presence. Guided by literature-based VR design principles, an enhanced PL-VTE module has been developed in Unity 3D and deployed on Meta Quest headsets. A mixed experimental design compared outcomes between VR-based and traditional training groups using pre- and post-tests, performance tracking, interviews, concluding, and presence questionnaires. Findings provide evidence-based guidelines for optimizing immersive VR training in engineering education and address existing gaps in VR-based instructional design. The study contributes to the advancement of pedagogically sound, accessible, and effective immersive learning environments for technical skill development.

Emmanuel Osei-Kwame, MS.EEN, Department of Engineering, presented a paper titled, *Development of a Multiuser Collaborative Virtual Training Environment for Photolithography Cleanroom Processes*, at the HBCU Chips Network Annual Conference, April 1-2, 2026 in Atlanta, GA. Co-authors: Michael Kozhevnikov and Yaw Amankrah Sam-Okyere.

The semiconductor industry relies heavily on photolithography processes conducted in controlled cleanroom environments, where training and collaboration are constrained by stringent contamination protocols, high operational costs, and physical limitations. To address these challenges, we present a novel immersive Collaborative Virtual Training Environment (CVTE) designed for multiuser interaction and collaboration. This system enables participants to engage in shared simulations of cleanroom workflows, fostering real-time teamwork without the risks associated with physical cleanrooms. Key features include synchronized multiuser avatars for interpersonal communication, controller-based interactions for manipulating virtual photolithography equipment (e.g., wafer handling, mask alignment, and exposure simulation), and environmental fidelity. Python scripting facilitates dynamic scenario customization, real-time physics simulations, and the integration of collaborative tools such as shared annotations and voice chat. Preliminary evaluations demonstrate low-latency synchronization across networked head-mounted displays (HMDs), achieving response times under 50ms for interactions, and high user immersion scores via standardized VR questionnaires. Our VTE represents a scalable solution for industrial training on semiconductor device fabrication, with potential extensions to other high-stakes manufacturing domains. Future work will incorporate haptic feedback and AI-driven adaptive scenarios to further elevate collaborative efficacy.

Youngjun Lee, Ph.D., Department of Engineering, attended and **Alexander Roque, MS.EEN,** presented *Experimental Evaluation of BNNT-based Thin Films for Mitigating Single Event Effects in SRAM via Proton Beams*, at the HBCU Chips Network Annual Conference, April 1-2, 2026 in Atlanta, GA. Co-authors: Hargsoon Yoon, Keun-Woo Lee, and Woong-Ki Kim.

Semiconductor chips in space are highly vulnerable to Single Event Effects (SEE) caused by highenergy radiation. While conventional bulk shielding is limited by mass and volume, lightweight solutions are essential for space system efficiency. This study investigates thin-film shielding materials utilizing Boron Nitride Nanotubes (BNNTs) and polymer composites. Due to their low atomic mass and high hydrogen-like atomic density, BNNTs are excellent candidates for slowing down incident protons. We evaluated the radiation shielding performance of BNNT-Parylene C composite films using a Static Random-Access Memory (SRAM) array exposed to 100 MeV proton beam. The results demonstrated that the shielding effectiveness varied based on film thickness and proton energy. Although the reduction in radiation effects was moderate, the findings validate the potential of BNNT-based thin films as lightweight shields against high-energy protons. Future work will focus on optimizing multilayer structures combining hydrogen-rich polymers and higher-density BNNT configurations to enhance shielding performance.

Andre Saffore, MS.EEN, Department of Engineering, presented a paper titled, *Broadband Surface Acoustic Wave Generation via Chirped IDTs for Programmable Spin Control*, At the HBCU Chips Network Annual Conference, April 1-2, 2026, in Atlanta, GA. Lead author is Felix Kimeu, PHD.MSE, Department of Physics.

Controlling spin states in quantum and magnetic materials using dynamic strain fields offers a promising route toward hybrid quantum and spintronic technologies. Surface acoustic waves (SAWs) provide a versatile mechanism for generating such strain via magnetoelastic or piezomagnetic coupling. However, conventional interdigital transducers (IDTs) are limited by narrow frequency bands. This narrow bandwidth limits the ability to address spin transitions across a range of energy scales to compensate for inhomogeneous broadening. This work focuses on designing and implementing chirped IDTs to generate broadband SAWs for tunable multi-frequency spin control. We first developed a predictive frequency-domain model of the chirped geometry on Mathcad, a computational software. To bridge the gap between theory and application, devices are fabricated on a 1280 YX cut lithium niobate substrate using the Nanyte Beam maskless lithography tool. We use the liftoff technique to create the device patterns. This approach bypasses the need for physical photomasks, enabling rapid prototyping of complex, customizable chirp profiles and varying electrode densities. Experimental RF characterization, performed via S-parameter measurements using the Tektronix RSA518A spectrum analyzer, confirms successful broadband operation. The results show strong agreement with our modeled spectra, validating the design's efficiency.

Ivy Krystal Jones, PhD, attended and presented on *"Mechanochemical Synthesis of Double Halide Perovskite Powder for Multifunctional: Magnetic-Fluorescent to Ionizing Radiation Detection Applications"* at the 2nd International Materials Summit on Nanomaterials & Nanoengineering, Las Vegas, Nevada, April 5th – 8th, 2026.


II International
Tropicana

Congratulations to Team Spartan Electric, **Wisdom Korkortsi (capt.), Yaw Amnkrah, Goddard Brookman, Samuel Kwawukame, Emmanuel Osei-Kwame, and Emmanuel Wiafe, MS.EEN,** Department of Engineering. This ambitious group of graduate Engineering students competed in the PEP26 National Competition, April 14-16, Portsmouth, VA, and placed 5th in a field of 16 teams from across the U.S. in the Uncrewed Open Division. It was the first time Norfolk State competed in the event sponsored by the American Society of Naval Engineers. The team looks forward to the chance to compete in the fully autonomous division in 2027.

$50,000 Awarded to SpartanEdge Med Systems Through National NSF I-Corps Program for Customer Discovery and Startup Development

Dr. Renny Fernandez's research group has been selected to participate in the NSF I-Corps National Teams Program (Spring Cohort 3) and has received $50,000 in funding to support participation in the customer discovery and commercialization training program. The award supports market validation, product refinement, entrepreneurial development, and advancing university-developed technology toward viable healthcare products and startup ventures. The team's successful completion of the Regional I-Corps program led to their advancement into the National I-Corps program.

The selected team includes **Dr. Renny Fernandez** as Principal Investigator; graduate students Santhosh Adhinarayanan, Harikrishnan Muraleedharan Jalajamony, and Soumadeep De, serving as Entrepreneurial Lead, Co-Entrepreneurial Lead, and Technical Lead, respectively; and Dr. Atiq Bhatti as Industry Mentor. Through the National I-Corps program, the team is undergoing intensive training in customer discovery, market validation, business model development, and commercialization strategy.

SpartanEdge Med Systems is developing a smart bandage platform for continuous wound monitoring using wearable sensors, embedded machine learning, and wireless connectivity. The system measures key wound indicators, including temperature, humidity, pressure, and various gases, to detect abnormalities in real time. On-device intelligence enables operation without constant internet access, helping protect patient privacy and reducing latency through real-time local processing. Bandage-to-bandage relay communication extends network coverage and reliability. The technology aims to support earlier intervention, reduce hospital readmissions, and improve outcomes in chronic wound care.

Journal Article Published: "Scalable Parallel Transmission in LoRa Networks: A Regulatory-Aware Analysis" in IEEE Open Journal of the Communications Society

Dr. Renny Fernandez's research group has achieved another major publication milestone with the research article "Scalable Parallel Transmission in LoRa Networks: A Regulatory-Aware Analysis," published in the IEEE Open Journal of the Communications Society. The article was authored by Soumadeep De, Santosh Joshi, Himanshu Upadhyay, and Renny Fernandez, in collaboration between Norfolk State University and Florida International University.

LoRa is widely used for long-range, low-power communication, but image transmission remains highly challenging because of its limited bandwidth and low data rate. This study developed a synchronized multi-radio LoRa architecture with up to 5 parallel radios, demonstrating a substantial reduction in transmission time for large payloads, such as images and bulk sensor data, while remaining compliant with FCC regulations. Experimental results showed a deviation of less than 2% from the analytical model, validating the proposed framework. The work also highlights the FCC 20-second dwell-time constraint as a key factor governing scalability and provides practical guidance for faster, regulation-compliant, and energy-aware long-range IoT communication systems.

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S. de, S. Joshi, H. Upadhyay and R. Fernandez, "Scalable Parallel Transmission in LoRa Networks: A Regulatory-Aware Analysis," in IEEE Open Journal of the Communications Society, vol. 7, pp. 3155-3167, 2026, doi: 10.1109/OJCOMS.2026.3679178.

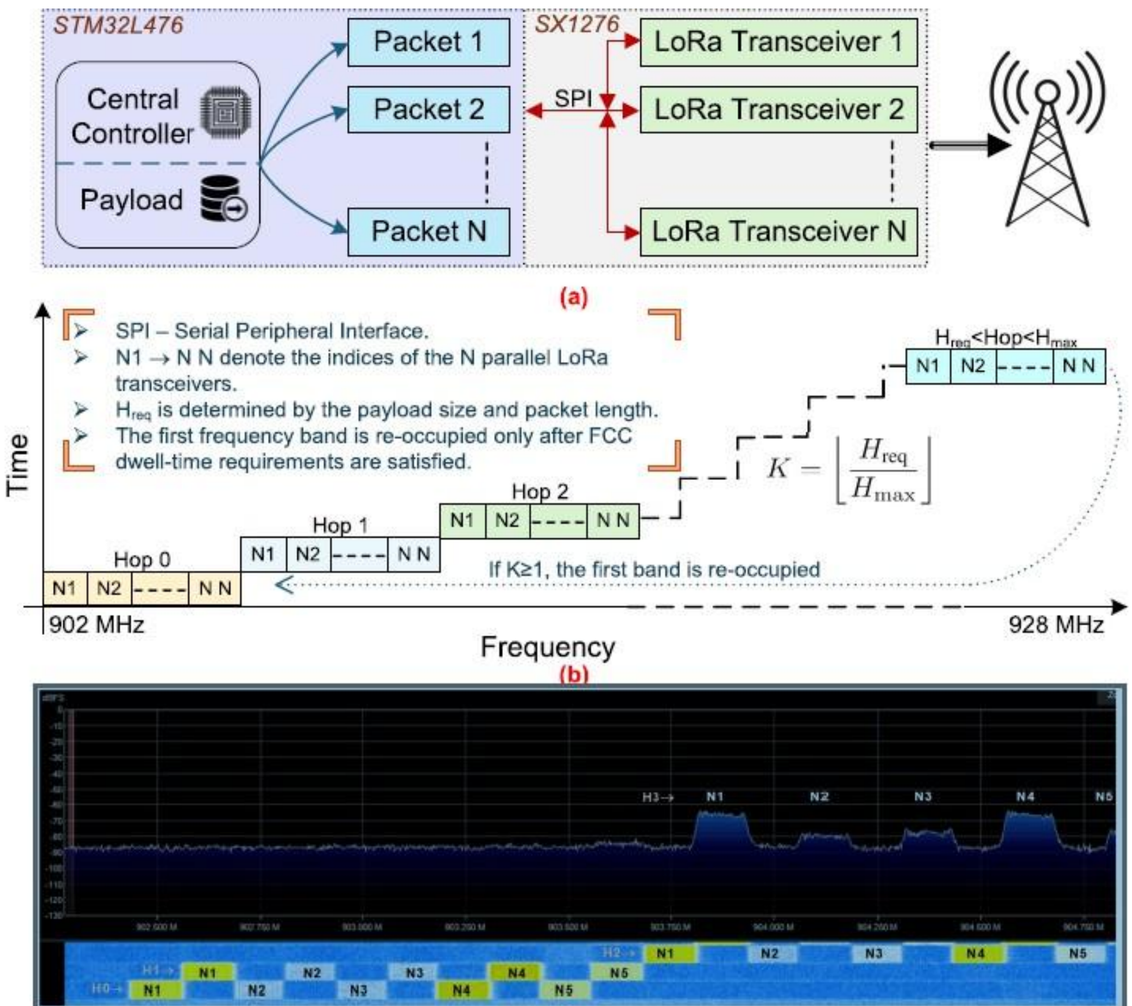

FIGURE 1. Block diagram of the parallel LoRa transmission system and the corresponding frequency-hopping sequence. (a) Payload partitioning and concurrent transmission across multiple LoRa transceivers controlled by a central processor. (b) Synchronous frequency progression across the US902–928 MHz ISM band, illustrating band reuse under FCC dwell-time constraints. (c) SDR waterfall capture generated by the implemented prototype with $N = 5$ parallel LoRa transceivers, demonstrating simultaneous transmissions across adjacent frequency channels. Labels $N1$-$N5$ denote nodes, while $H0$-$H3$ indicate hop indices. The observed BW offset between hops validates the deterministic progression scheme.