MESSAGE FROM THE CHAIR

Friends and Colleagues,

Amidst the challenges of 2020, I am grateful that we enjoyed some unexpected bright spots, particularly in the area of funding!

• In a nearly unprecedented event, the Department won two NSF Emerging Frontiers in Research and Innovation (EFRI) grants—rare for a single university, and practically unheard of for a single department.

• In addition, two projects were funded in the cutting-edge NSF 2026 Idea Machine competition.

• We were also excited to be the first program at Ohio State to win support from the facebook-funded Chan Zuckerberg Foundation.

• Due to its economic viability, Winston Ho’s carbon-capturing membrane technology is the only carbon-capture project the Department of Energy is choosing to support this year for engineering-scale testing.

• The NIH funded research on blood substitutes and optimizing viral disease testing, both efforts highly relevant to the Covid-19 outbreak.

Details about these awards are on page 12 if you would like to know more.

I hope we can all relish a more normal life of teaching, research and service this coming year, and best wishes for all of your upcoming endeavors and triumphs.

Umit S. Ozkan
Department Chair
Distinguished University Professor
College of Engineering Distinguished Professor

Spring 2021
Ayanna Howard Named Dean, College of Engineering

Sitting in his wheelchair with a robot-equipped stuffed animal, the boy beamed when he realized his movements caused a character in the game to react. He was in control. It was a gift—for the boy with cerebral palsy and for Ayanna Howard. “At that moment, I realized we were doing the right thing,” she said.

Howard, who traces his interest in teaching to a childhood fascination with the TV show “Bionic Woman,” now serves as dean of Ohio State’s College of Engineering.

“I was a total science fiction nut, so anything that flew, had robots or superheroes, I was there,” she said in an NBC4 interview. And what was once the premise of a sci-fi TV show is now the life’s work of Howard, who traces her inspiration for developing robots to help children with special needs achieve educational and therapy goals.

Dr. Howard joined Ohio State March 1, succeeding David B. Williams, who led the College’s unprecedented growth over the last decade.

“I’m thrilled to join Ohio State at a time in which there is so much potential to strengthen and build new partnerships in order to expand access and enhance opportunities for the next generation of students, alumni, and for economic development throughout Ohio,” said Dr. Howard.

“Dr. Howard is an innovator whose skills and passion are a perfect fit with Ohio State’s focus on convergent research and discovery,” said President Kristina M. Johnson. “To attract a leader of her caliber shows both the strength of our engineering program and the acceleration of the university’s overall research mission.”

Ayanna Howard’s robotics research center around the concept of humanized intelligence—embedding human cognitive capability into the control path of automated systems. Her Georgia Tech HumAnS Lab uses techniques such as sensing and learning to enhance the autonomous capabilities of robots and computerized systems. The HumAnS Lab has generated more than 250 publications and $8.5 million in principal investigators-led research funding.

Earlier in her career, Howard worked in NASA’s Jet Propulsion Laboratory as senior robotics researcher and deputy manager in the Office of the Chief Scientist. She was involved in developing SmartNav—an autonomous, next-generation Mars rover—and SnoMotes, toy-sized robots that can explore icy terrain that is too dangerous for scientists.

She founded her company, ZyroRobotics, in 2013, based on a patent for a device that could enable children with disabilities to interact with tablets. During her work with ZyroRobotics, Dr. Howard discovered a passion for teaching. This led to her coming to Ohio State, where she has become the first woman to serve as dean.

Throughout her career, Howard has been active in helping to diversify the engineering profession for women, underrepresented minorities, and individuals with disabilities. “Community and inclusive excellence are a passion for me, and innovation are my passions,” said Howard.

Executive Vice President and Provost Bruce A. McPheron noted that Dean Howard joins Ohio State at an opportune moment: a $100 million State of Ohio investment will increase convergent research initiatives, strengthen student-industry partnerships, and grow the number of STEM graduates.

Howard is a vocal proponent of “convergent research.” She describes it as “interesting solutions happening at the intersection of disciplines.” But the 2020 ANNUAL REPORT

2020

2020 ANNUAL REPORT

Inspiring Black Scientists in America.”

Among many accolades, Forbes named Dr. Howard to its America’s Top 50 Women In Tech list. Recently, she became an Institute of Electrical & Electronics Engineers (IEEE) Fellow for her contributions to human-robot interaction systems, and was a Champion Award recipient of Silicon Valley Robotics Industry’s inaugural Good Robot Awards. In addition, she is included in Cell Mentor’s list of “1,000 Inspiring Black Scientists in America.”

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Faculty
23 tenure-track
- 3 NAE members
- 4 endowed chairs
- 3 professorships
- 4 distinguished professors

awards & honors
9 national / international, including:
- ACLA: Education Leadership Award
- IFAC World Congress: Best Paper
- RSC: Emerging Investigator
- SciLog Fellow
- Univ of Macao: Visiting Scholar

research expenditures
- $8 million
- 86 active grants

publications
- 168 peer-reviewed articles
- 5 books edited
- 9 book chapters

entrepreneurial
- 2 companies launched
- 2 in pilot / engineering scale
- 4 patents received

lectures
- 36 invited lectures
- 6 keynotes, 4 distinguished

Graduate Program
awards & honors
11 national honors:
- 6 Fellowships
- AGERS Travel Award
- 1 NSF Graduate Research Fellowship
- 2 honorable mentions

Publication honors, including:
- Chemical Engineering & Processing
- Chemical Engineering Science
- Nature Communications

degrees
14 Doctoral, 20 Masters

Undergraduate Program
awards & honors
4 national honors:
- American Indian Science and Engineering Society
- NSF Graduate Research Fellowship
- Fulbright MITACS Globalink
- US Dept of Energy Solar Cup

degrees
183 Bachelor degrees

USNWR Rankings (2021-22)
#28 CHE Graduate Program
#21 CHE Undergraduate Program (2021)
#16 College of Engineering Graduate Program
#1 College of Engineering Graduate and Undergraduate Programs
Distinguished Lectures and Keynotes

Bhavik Bakshi

Nicholas A. Brunelli

W.S. Winston Ho

David W. Wood

Shang-Tian Yang
• University of Macao Distinguished Visiting Scholars (MDS) Lecture: “Renewable biofuels and chemicals from food processing wastes using novel fermentation processes and metabolically engineered microbes.” Macao, China, June 2020 (pandemic-postponed).

2020 National/International Awards

Bhavik Bakshi
• American Council for Life Cycle Assessment: 2020 Education Leadership Award

Nicholas Brunelli
• Royal Society of Chemistry, Molecular Systems Design and Engineering: 2020 Emerging Investigator Award

Stuart Cooper
• American Chemical Society: Elected Fellow, Polymers Division
• Florida State University: Named to Chemical Engineering Advisory Board

W.S. Winston Ho
• National Taiwan University: 2020 Outstanding Alumnus Award
• Indian Institute of Technology: Honorary Faculty

Li-Chiang Lin
• Research Corporation for Science Advancement: Scialog Fellow - Negative Emissions Science

Jessica Winter
• Florida Association of Nanotechnology: Fellow

Shang-Tian Yang
• University of Macao: Distinguished Visiting Scholar (postponed).

Honorific Appointments

Jeffrey Chalmers
• Named the Helen C. Kurtz Chair

André Palmer
• Named Fenburr Ohio Eminent Scholar

National Media

Jessica Winter
• National Nanotechnology Initiative (Nano.gov), Three-part interview series with Lisa Friedersdorf, director of the National Nanotechnology Coordination Office on Winter’s work with quantum dots / biomarkers / nanotechnology for detecting cancer earlier.

David Wood

Jessica Winter
• Florida Association of Nanotechnology: Fellow

Shang-Tian Yang
• University of Macao: Distinguished Visiting Scholar (postponed).
Entrepreneurial Activities

W.S. Winston Ho
The effort to commercialize Winston Ho’s carbon-capturing membrane technology is moving to engineering scale. Ho’s technology could help decarbonize flue gas from fossil fuel-burning power plants while providing the captured CO₂—which is 95% pure at bench scale—to industry. This is important because demand for quality CO₂ is growing in the oil, chemical and food industries.

Jessica Winter
With a ramp-up boost from an NSF SBIR phase II award, Winter’s company, Core Quantum Technologies, began reagent sales of its magnetic nanoparticles in January 2020. The nanoparticles can be used for both diagnostics and cell separation and would help biobanks researchers to identify and isolate cell types.

David Wood
David Wood and Izabela Gierach founded Protein Capture Science (PCS), LLC to develop, manufacture and directly distribute biopharmaceutical manufacturing technology to potential users in industry, academia and government research laboratories. With additional startup grants from the university and state of Ohio, PCS hopes to launch the product summer 2021.

Nicholas A. Brunelli

Eduardo Reátegui

Katelyn Swindle-Reilly

David Wood

Patents

Nicholas A. Brunelli

Eduardo Reátegui

Katelyn Swindle-Reilly

David Wood
$2.7M, 4 years – Blood substitutes

With blood shortages and supplies at risk due to infectious diseases such as COVID-19, safe and effective blood substitutes for use in transfusion medicine are more important than ever. Professor Andre Palmer has dedicated 20 years to this research, supported by multiple federal grants. Under Palmer’s new NIH funding, Professor David Wood joins the effort to develop chemically well-defined red blood cell (RBC) substitutes that could help save lives.

$1.8M, 2 years – Optimized Covid-19 testing

Assistant Professor Eduardo Reátegui and Professor Emeritus L. James Lee are leading interdisciplinary efforts to optimize Covid-19 testing to combat the coronavirus pandemic and address future viral outbreaks. The method uses existing microarray technology they initially developed for the characterization of single extracellular vesicles from biofluids. Once optimized, the new method could potentially improve accuracy up to 100x.

$2M, 4 years – Creating Value from Stranded Natural Gas

Led by Distinguished University/C. John Easton Professor L.-S. Fan, the project will develop a small-scale modular chemical processing system to convert stranded natural gas and carbon dioxide into value-added liquid fuel products. Stranded natural gas resources are currently flared due to economic limitations associated with prohibitive transportation costs and small reservoir sizes. Successfully transforming these remotely distributed gas resources to useful energy products will contribute significantly to the U.S. economy and its energy security.

$2M, 4 years – Eliminating End-of-Life Plastics

Morrow Professor Bhavik Bakshi’s multidisciplinary team will develop methods and tools for the assessment, design, and innovation of Sustainable and Circular Engineering for the Elimination of End-of-Life Plastics. A linear model of resource consumption includes resource extraction, manufacturing, distribution, and use, followed by disposal. Conversely, in a circular economy, goods are reused, repaired, or remanufactured, thereby taken back into the product cycle. Assistant Professor Li-Chiang Lin is a co-PI.

$900k – Inflammation research

Facebook’s foundation makes its Ohio State debut with a grant to a team led by Assistant Professor Eduardo Reátegui. Founded by Facebook CEO Mark Zuckerberg and wife Priscilla Chan, CZI recently announced $14 million in funding to support 29 interdisciplinary teams and build a network of researchers to increase understanding of inflammation and help cure, prevent or manage disease. Reátegui will explore inflammation of the lungs, which could be highly relevant in the treatment of coronavirus patients.

$300k, 2 years - Accounting for Nature

The NSF advanced 25 new projects to explore bold new ideas for transformative research – including two zero-waste projects led by Bhavik Bakshi. Assistant Professor Joel Paulson joins Bakshi in researching how engineering systems can be designed to account for the role nature can play while respecting ecosystem limits and contributing to human well-being.

$100k, 1 year - Envisioning Zero Waste

Bakshi’s second project is a series of workshops to bring together a diverse group of stakeholders across many disciplines (engineering, economics, social sciences, environmental science), and sectors (academia, industry, government and non-governmental organizations). The group will explore integration of knowledge, methods, models, and data necessary to envision a zero-waste world that is economically feasible, socially desirable, and environmentally viable and creating and evaluating potential solutions.
Liang-Shih Fan
Distinguished University Professor / C. John Easton Professor

L.-S. Fan is one of the world’s leading authorities on particulates and multiphase reaction engineering (PMRE), which studies the flow behavior of particulate material with gas, or gas-liquid mixtures and their accompanying chemical reactions. He invented several industrially-viable clean energy conversion processes and emissions control technologies, including the Ohio State Coal Ash Reactivation (OSCAR) process for SO₂ and heavy metal capture. The Carbonation-Calcination Reaction (CCR) process, for which Fan received the R&D 100 award, was developed to capture CO₂ produced from power and chemical plants and was commercially licensed for cement manufacturing. Fan also invented a novel non-invasive volume imaging technology known as Electrical Capacitance Volume Tomography (ECVT), which Tech4Imaging has sold successfully to clients such as the NASA Research program. Fan’s redox chemical looping technologies for electricity, syngas, hydrogen, and chemical (e.g. methanol, acetic acid, and liquid fuels) produce under CO₂-emission neutral or negative conditions. His new company is commercializing the technology with clean hydrogen and power generation being the first industrial applications of interest.

W.S. Winston Ho
Distinguished Professor

The research of Winston Ho and Prabir Dutta led to a more economical CO₂ capture membrane. Specifically, they developed an economical hybrid membrane that combines the separation performance of inorganic membranes with the cost-effectiveness of polymer membranes. This discovery is a key component in the global race for clean energy and has commercial potential for use for coal-fired power plants.

L. James Lee
Professor Emeritus

Jim Lee co-led a study that developed a new regenerative medicine technology. Called Tissue Nanotransfection (TNT), this nanochip technology provides an electric spark to skin cells that is harmless to the body and reprograms nerve cells, blood vessels, and organs.

In research studies with mice and pigs, researchers were able to reprogram skin cells to become vascular cells and regenerated blood flow in injured areas that lacked blood flow previously. Not only does this technology have applicability in wound care, it has been able to reprogram skin cells into nerve cells that were injected into brain-injured mice to help them recover from strokes.
Umit S. Ozkan
Distinguished University Professor
College of Engineering Distinguished Professor and Department Chair

Umit Ozkan’s pioneering research into hydrogen fuel cell catalysts led to the development of the first heteroatom-doped carbon-nanostructures (CNx) to be used for the acidic oxygen reduction reaction in proton exchange membrane (PEM) fuel cells. The catalysts developed in her lab were patented and are being commercially produced by pH Matter, LLC. The discovery of these CNx materials was a key milestone in the development of non-precious metal catalysts for a variety of electrochemical applications in renewable energy technologies. These materials could be synthesized with wide-ranging morphologies such as graphitic sheets, stacked cups and nanotubes. CNx can also be used in direct methanol fuel cells (DMFC) and air-metal batteries.

Andre Palmer
Professor

Andre Palmer is a world-renowned blood substitute researcher. Through his research he is developing safer, more commercially viable red blood cell substitutes that can provide patients valuable time until they receive a human blood transfusion. He is a fellow of the American Institute for Medical and Biological Engineering and has received the College of Engineering’s Harrison Faculty Award for Excellence in Engineering Education. In addition, he was named an Ohio Eminent Scholar by the Ohio Department of Higher Education for his groundbreaking work.

Jessica O. Winter
Professor

Jessica Winter is an established leader in nanobiotechnology who has invented materials used in cancer detection and research. Her method of tightly packing multiple nanoparticles in polymer carriers so that their properties can be multiplied led to her development of MultiDot, a group of semiconductor nanoparticle quantum dots that allow researchers to track tagged molecules. In biomedical applications, researchers can attach the MultiDot to specific cell structures and better identify and understand disease progression. A product variation called Magdot adds magnetic particles to enable separation and manipulation of cellular biomarkers. Her company, Core Quantum Technologies, focuses on a nanoparticle diagnostic that matches cancer patients to therapies, allowing patients to become fully informed about the best possible

Barbara Wyslouzil
Professor

Barbara Wyslouzil is credited with creating the world’s most cubic ice. Because of her research, computer models showing how clouds interact with sunlight and the atmosphere, can be improved. Additionally, her studies have provided valuable information pertaining to theories on climate change and its role on our planet. Wyslouzil was elected a lifetime Fellow of the American Association of Aerosol Research (AAAR) for her significant contributions within the field of aerosol science. In addition to receiving this prestigious award, Wyslouzil’s work has been published in numerous publications, including Journal of Chemical Physics and Chemistry World.
Melvin DeGroote

Melvin DeGroote (1895-1963) has been recognized as one of America’s greatest inventors of all time and has been listed on over 900 U.S. patents. In 2000, TIME magazine’s millennium issue recognized him as one of the most prolific inventors in the United States in regards to the number of patents issued to him. In fact, he was second on the list only to Thomas Edison.

DeGroote invented and patented many of the de-emulsifying agents that separate crude oil from impurities crucial to the process of oil production. He also invented the chemical recipe that allows chocolate to stick to ice cream, leading to the creation of the Eskimo Pie.

He graduated with an Ohio State degree in chemical engineering in 1915 and received his MS and honorary doctorate of science degrees from Ohio State in 1942 and 1955, respectively.

Harry Roger Drackett

Harry Drackett (1885-1948) graduated from The Ohio State University in 1907 with a bachelor of science in chemical engineering.

He eventually went to work for the company his parents founded, P.W. Drackett & Sons, which developed industrial and home care cleaning products, based in Cincinnati. In 1933, Drackett developed Windex, which because of its convenience and successful advertising soon became the first successful glass cleaner on the market.

Drackett remained active with Ohio State after his graduation and served on many boards and committees, including as chair of the Alumni Advisory Board for ten years. Drackett Tower, a residence hall which opened in 1965, was named for him in recognition of his service to the university.
Prasad Ramanathan (‘92 PhD) was named Fellow, holding the M.M. Sharma Distinguished Visiting Professorship in Chemical Engineering at the Institute of Chemical Technology in Mumbai, India. An expert in AI and cognitive automation, Ramanathan is Senior Director of Capgemini India, where he leads the automation drive academy in Group Industrialization & Automation.

Elif Miskioglu (‘15 MS/PhD) was named Bucknell University’s Assistant Professor; Elif Miskioglu (‘15 MS/PhD) to its “2020 35 Under 35” list. To improve inclusivity, Professor Miskioglu studies the development of engineering expertise via the construct of intuition and its role in on-the-job judgements, as well as evidence-based methods for improving the support structures of underrepresented minorities in STEM.

Janani Sampath (‘18 PhD) started her independent career in academia at the University of Florida as an assistant professor. Dr. Sampath completed her postdoctoral fellowships at the University of Washington and Pacific Northwest National Laboratory. Her research areas are polymers, proteins, and hybrid next-generation soft materials.
Student Publication Honors

American Institute of Chemical Engineers (AIChE), Sustainable Engineering Forum (SEF)


Biomicrofluidics: Biomicrofluidics


Biotechnology and Bioengineering


Bioresource Technology

• Daiana Wischral: 2020 CAPES/Natura Campus Award for Excellence in Research for her dissertation, “Production of 1,3-propanediol by Clostridium beijerinckii DSM 791 from crude glycerol and corn steep liquor: process optimization and metabolic engineering.” (Yang Group).

Chemical Engineering & Processing - Process Intensification

• Frank (Fanhe) Kong: Cover feature, “Process intensification by applying chemical looping in natural gas to dimethyl ether conversion process—Implications for process design education.” CEP, Vol 143, September 2019, 107566. (Fan Group).


Nature Communications

• Yan Liu, Lang Qin, Zhuo Cheng, Josh W. Goetze, Fanhe Kong, Jonathan A. Fan: Editors’ Highlight, January 31, 2020. “Developing a mesoporous silica-supported nanoparticle oxygen carrier that enables a near 100% CO generation with high recyclability at a significantly lower temperature range than in conventional oxygen carrier systems.” The value of product selectivity is so far the highest observed for chemical looping systems. (Fan Group).

Awards and Honors

American Indian Science and Engineering Society (AISES) National Conference

• Michael Charles: Second Place, Graduate Poster Research Competition, “Achieving Campus Carbon Neutrality with both Technological and Ecological Solutions.” Charles attended the conference on an NSF ASSIST grant. (Bakshi Group).

• Anna Grondolsky: First Prize, Undergraduate Oral Research Presentation, “Reversible Fuel Cell Technology.”

Fulbright-MITACS Globalink Grant

• Jacob Belding

National Science Foundation: 2020 Graduate Research Fellowships

• Thomas Porter: 20 Fellowship
• Vasiliki “Aliki” Koliopoulos: 18 Fellowship
• Sabat Gonzalez-Serrano: Honorable Mention
• Xilal Rima: Honorable Mention

North American Membrane Society (NAMS)

• Ting-Yu Chen: 2020 Elias Klein Founders’ Travel Award, “Synthesis of Sterically Hindered Polyvinylamine and its Application in Facilitated Transport Membranes for CO2 Capture from Flue Gas.”

Society for the Advancement of Chicanos/Hispanics and Native Americans in Science, National Diversity in STEM Conference

• Xilal Rima: Oral presentation award for his research on the role of extracellular vesicles (EVs) in dormant circulating tumor cells in metastasis.

U.S. Department of Energy

• Zahra Amin, Rupal Jindal: 2020 Solar District Cup - Collegiate Design Competition.

American Institute of Chemical Engineers (AIChE), Sustainable Engineering Forum (SEF)


Biomicrofluidics: Biomicrofluidics


Biotechnology and Bioengineering


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