



## US National Science Foundation opens Technology Directorate

By Henry Quansah Afful and Judy Meiksin

For the first time in more than 30 years, the US National Science Foundation (NSF) has opened a new unit for funding, the Directorate for Technology, Innovation and Partnerships (TIP). NSF Director Sethuraman Panchanathan made the announcement in March 2022. Among the areas of interest are artificial intelligence systems, semiconductors, biotechnology, cybersecurity, next-generation wireless networks, and quantum computing platforms.

NSF is repositioning much of its existing innovation and translation portfolio into the TIP Directorate, including the NSF Lab-to-Market Platform comprising the NSF Innovation Corps (I-Corps), Partnerships for Innovation, and America's Seed Fund powered by NSF programs, as well as the NSF Convergence Accelerator, according to a news release.

"These already existing funding programs within NSF have been of tremendous help in getting products from the lab scale to market, especially for researchers in academia. Such programs as the

I-Corps help researchers demonstrate a proof-of-concept product without taking on a huge personal risk to innovate with the technology," says Etosha Cave, a co-founder and CSO of Twelve—a company that recycles carbon dioxide into essential products—in an interview with *MRS Bulletin*. At Twelve, researchers have developed a novel catalyst that "electrifies" CO<sub>2</sub> and water, releasing oxygen and carbon monoxide as the main outputs. Through this reduction process, carbon can be converted into useful chemicals, materials, and fuels.

In an email to *MRS Bulletin*, Erwin Gianchandani, the assistant director of TIP, described new programs through the directorate that support use-inspired research and innovation, new translational pathways, and workforce development. "Earlier this year, TIP launched the Pathways to Enable Open-Source Ecosystems, or POSE, program, which is focused on fostering open-source ecosystems and seeking to advance software, data, modeling, and other novel techniques across all

fields of science and engineering," Gianchandani wrote.

TIP has also started new programs such as the NSF Regional Innovation Engines. These programs seek to tap into the diversity of disciplines and backgrounds of individuals to drive research aimed at solving national-scale

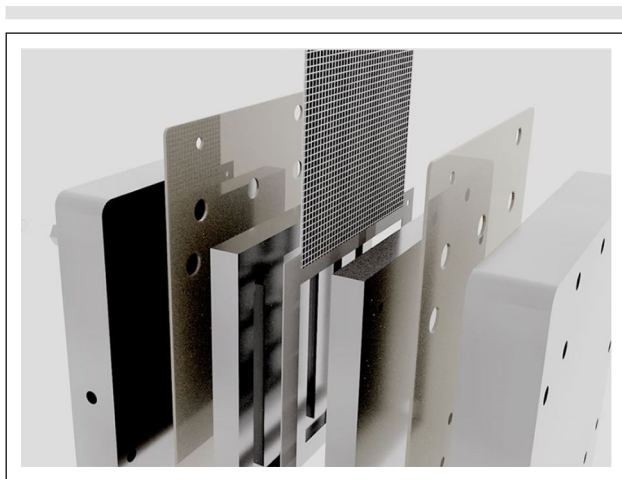
problems. Through these programs, participants are mentored and trained on the innovation process, transforming ideas into solutions to everyday problems.

"This process of taking ideas to market involves gauging the expectations of the market and trends to help develop specific use cases needed by consumers. Conducting such market analyses and developing prototypes requires a lot of money, and consulting venture capitalists or Angel investors can mean a reduction in the equity of the inventors once the product goes to market. This can disincentivize researchers from taking products to market," says Orlando Auciello, a Distinguished Endowed Chair Professor at The University of Texas at Dallas and a co-founder of three companies including Advanced Diamond Technologies, Original Biomedical Implants-USA, and Original Biomedical Implants-Mexico.

Cave also told *MRS Bulletin* that "NSF's programs have, in the past, provided the required seed money to help take products to market and also help researchers to interact with consumers through the training programs offered."

The mission of TIP is heavily centered around fostering use-inspired design and establishing translational pathways to carry ideas to the market. Thus, requiring multidisciplinary teams will encourage researchers to team up with colleagues in other fields of study to drive solutions to today's problems. This helps to tap into the country's diverse talent pool and drive partnerships among academia, industry, and government.

It is well known that a lot of researchers in academia do not conduct use-inspired research that keeps the end-user in mind during the research



Within this reactor, a novel catalyst "electrifies" CO<sub>2</sub> and water releasing oxygen and carbon monoxide as the main outputs. Image courtesy: Twelve.

process. Instead, academics prefer to focus on the scientific outcomes of research and ways of improving upon these outcomes. As a result, a lot of academic research work remains in the laboratory without resulting in tangible products that benefit society.

“In the academic community, we need to open up our minds to consider alternate career routes including starting companies based on scientific outcomes. This will help bridge the gap between science and consumers,” says Auciello in an interview with *MRS Bulletin*. He has developed a graduate-level course at The University of Texas at Dallas geared toward encouraging graduate students to consider starting their own companies.

Some factors that could deter academics from starting their own companies include the inability and/or reluctance to communicate across disciplines, and the funding to push ideas to market. “Moving ideas from the laboratory scale to market often requires cross-disciplinary research,” says Dawnielle Farrar-Gaines, a distinguished research scientist, inventor, and adjunct professor at the Johns Hopkins University Whiting School of Engineering.

Farrar-Gaines was a working professional in electrical engineering before venturing into materials science. As a graduate student, she embraced the materials discipline to help her not only solve problems at the intersection of electrical engineering and materials science, but to also foster interactions with materials researchers

to drive greater innovation. During an interview with *MRS Bulletin*, she mentioned that she previously partnered with an otolaryngology surgeon to develop a piezoelectric technology that could be used during surgeries to help restore hearing to patients with middle-ear damage or disease, thus improving surgical outcomes. This work encompassed chemistry, engineering, materials, medicine, manufacturing, and regulatory awareness—especially for effective use in a surgical environment.

“The directorate is a worthwhile initiative that encourages researchers to examine their Intellectual Property in terms of the market and end-user to yield products that are impactful, application-oriented, and offer significant commercialization potential,” Farrar-Gaines says.

“NSF’s TIP

Directorate will accelerate discovery and innovation to rapidly bring new technologies to market and address the most pressing societal and economic challenges of our time,” says Panchanathan in a news release. “By pursuing new approaches that engage the nation’s broad and diverse population in shaping research directions and outcomes, TIP will be a game-changer in terms of the pace of technological breakthroughs, future job growth, and national competitiveness.”

## TIP Programs

### ■ America’s Seed Fund

This program focuses on transforming scientific and engineering discoveries into products and services with commercial and societal impact. The deep technologies funded show promise but their success has not yet been validated.

### ■ Convergence Accelerator

Launched in 2019, the NSF Convergence Accelerator builds upon basic research and discovery to accelerate solutions toward societal impact. The program funds teams to solve societal challenges through convergence research and innovation. To enhance its impact, the Accelerator also places teams together in cohorts, synergizing their work through facilitated collaboration.

### ■ Innovation Corps (I-Corps)

This program is an immersive, entrepreneurial training program that facilitates the transformation of invention to impact. This immersive, seven-week experiential training program prepares scientists and engineers to extend their focus beyond the university laboratory—accelerating the economic and societal benefits of NSF-funded and other basic research projects that are ready to move toward commercialization.

### ■ Partnerships for Innovation

This program offers researchers a technology testbed to gain market insights, launch a commercial application, or facilitate industry adoption. The program helps researchers translate basic research into technologies and spurs university spin-off companies.

### ■ Pathways to Enable Open-Source Ecosystems

The purpose of this program is to harness the power of open-source development for the creation of new technology solutions to problems of national and societal importance. Many NSF-funded research projects result in publicly accessible, modifiable, and distributable open-sourced software, hardware, or data platforms that catalyze further innovation.

### ■ Regional Innovation Engines

This program uniquely harnesses the country’s science and technology R&D enterprise and regional-level resources. NSF Engines can catalyze robust partnerships rooted in scientific and technological innovation to positively impact the economy within a geographic region, address societal challenges, and advance national competitiveness.

Source: US National Science Foundation, <https://beta.nsf.gov/tip/latest>



Already, in response to a call for proposals from the new NSF Regional Innovation Engines program, which supports use-inspired R&D in every region of the United States, NSF has accepted nearly 700 Concept Outlines—at least one from every state and US territory—that has advanced to the full proposal stage by mid-summer. Gianchandani told *MRS Bulletin*, “Over 40% of the participating organizations have not previously engaged with NSF.”

Gianchandani told *MRS Bulletin* that the CHIPS and Science Act of 2022 authorizes the TIP Directorate and several of its programs, including the new NSF Engines program described earlier. “The CHIPS and Science Act also underscores that research and development fuels production, and production

can fuel new research and development,” Gianchandani wrote to *MRS Bulletin* in an email.

In order to develop technological breakthroughs, TIP is also positioned to cultivate new education pathways leading to a diverse and skilled future technical workforce. This is what interests David Parrillo, the Vice President of Research & Development (R&D) for Dow Core R&D, a global R&D organization that drives the long-term R&D vision for Dow.

Parrillo told *MRS Bulletin* that Dow—as a company heavily engaged in use-inspired research that hires graduates from universities and community colleges—has a lot to benefit from the new directorate. The directorate’s mission includes supporting future leaders

in the science, technology, engineering, and mathematics (STEM) fields.

“In the US, there are 800,000 STEM degrees awarded every year and approximately 12 MM STEM jobs. It is estimated that internships in the US today in ALL fields is only on the order of 1.5 MM,” Parrillo tells *MRS Bulletin* in an email. “The TIP Directorate of NSF can really be a catalyst to dramatically increase the number of STEM internships as one portion of its mission to drive collaboration and focus efforts on use-inspired research,” he writes.

“This has the possibility to be an at-scale educational innovation,” Parrillo writes. “A long-range goal would be an internship for each STEM graduate!”

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