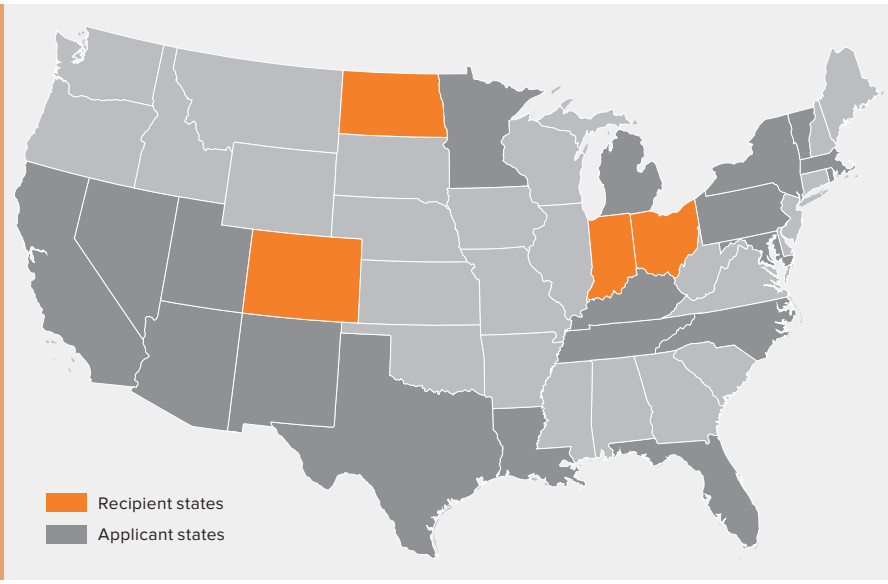
CHAIN REACTION INNOVATIONS

Argonne NATIONAL LABORATORY

CRI'S FIRST-EVER COHORT FEATURES DIVERSE SET OF INNOVATORS AND IDEAS



Applicants for CRI came from 22 states. About 50% of applicants were with startups; the rest were students, professors, postdocs or members of industry. The four recipients represent Colorado, Indiana, North Dakota and Ohio.

PLASMA-ASSISTED COMBUSTION FOR JET ENGINES AND GAS TURBINES

Felipe Gomez del Campo

Felipe is the founder and the CEO of FGC Plasma Solutions, a Cleveland-based company that is developing a novel fuel injector for jet engines and gas turbines. He has a bachelor's degree in mechanical and aerospace engineering from Case Western Reserve University.

TECHNOLOGY SUMMARY

FGC Plasma Solutions is working on a better fuel injector that incorporates plasma to better control combustion in jet engines and gas turbines. By reducing fuel consumptions during idling, between 1 percent to 5 percent fuel savings per flight are possible. This technology will also enable benefits from lower emissions; increased fuel flexibility; and improved reliability.

CRITICAL NEED FOR THIS TECHNOLOGY

Jet engines

Jet engine and gas turbine combustor design necessitates a trade-off between stability and optimum operation. The FGC technology will provide a single-point solution for many of these trade-offs in combustion chamber design.

Jet engines require a large amount of fuel to maintain stability when idling. The FGC design can save an average of 2.5 percent to 4.5 percent in fuel consumption for domestic aircraft. This could result in reduction of 20 million metric tons of CO_2 per year and a fuel savings of more than $1 billion annually.

Gas turbines

In gas turbines, the need to operate combustors at low fuel-air ratios in order to minimize noxious emissions leaves combustors prone to combustion dynamics that cause large vibrations in the engine, resulting in more than $1 billion in damage annually to the industry.

Turbines also can't tolerate certain variations in fuel compositions, thus eliminating the ability to switch fuels easily. The FGC technology would enable the use of low-British Thermal Units (BTU) fuels, which could save up to 1.5 quadrillion BTUs per year.

A NOVEL RADIOISOTOPE BATTERY MADE FROM NUCLEAR WASTE

Ian Hamilton

Ian holds a bachelor's degree in materials science engineering and is pursuing a master's in nuclear engineering, both at Purdue University. He also is the founder and CEO of Atlas Energy Systems, an energy-development company focused on the conversion of nuclear waste into usable energy.

TECHNOLOGY SUMMARY

The Atlas Energy Systems technology is significant in that it provides a way to turn high-level radioactive decay products from spent nuclear fuel into a usable energy source via radioisotope plasma generation. This material is usually considered nuclear waste to be stored and buried, but it still contains large amounts of residual energy. With the growing demands for energy from all sorts of sources, spent nuclear fuel should be further utilized as an energy source rather than buried and thrown away.

CRITICAL NEED FOR THIS TECHNOLOGY

The nuclear fuel process creates a by-product of radioisotopes from the fission process that is highly radioactive waste and must be stored securely for decades until it is considered safe. This technology converts the radioisotopes in the waste into energy, which reduces the amount of storage space needed for nuclear waste. In addition, this technology can replace other energy sources such as gasoline and lithium-ion batteries, reducing their negative environmental impacts caused by emission and metal waste products, respectively.

MEMBRANE-FREE ELECTROCHEMICAL DEVICES

Chad Mason

Chad holds a master's degree in engineering technology from Arizona State University and a bachelor's in electrical engineering from North Dakota State University. His most recent work was in the fuel cell durability team at General Motors.

TECHNOLOGY SUMMARY

This technology seeks to enable new applications for electrochemical devices by eliminating the need for electrolytes to act as electronic insulators. These new applications could include batteries, fuel cells, electrolyzers, and chemical production. This would lower costs, increase efficiency, and improve robustness without the need for excessive balancing of plant and control systems.

CRITICAL NEED FOR THIS TECHNOLOGY

The large-scale implementation of new energy systems and industrial methods that utilize advanced electrochemical technologies will create new economic opportunities. This also would increase national energy security by reducing dependence on foreign energy sources.

The prohibitive cost of designing, developing, and producing such electrochemical devices, limits their deployment. Eliminating the membrane in many applications will substantially improve their cost competitiveness and overall effectiveness.

CARBON MATERIAL SYNTHESIS THROUGH SUSTAINABLE BIO-MANUFACTURING METHODS

Tyler Huggins

Tyler holds a Ph.D in environmental engineering from the University of Colorado, Boulder, and a master's degree in environmental and sustainable engineering from the University of Colorado, Denver. In addition, he earned a bachelor's degree in biology from the University of Montana. Huggins, along with Justin Whiteley, co-founded Emergy, LLC, a company that focuses on advanced carbon material synthesis through biofabrication.

Justin Whiteley

Justin holds a master's degree in mechanical engineering from the University of Colorado, Boulder, and a bachelor's degree in mechanical and nuclear engineering from the University of California, Berkeley.

TECHNOLOGY SUMMARY

Emergy has developed a versatile bio-manufacturing process to make low cost advanced porous carbon materials for energy storage and filtration applications. Emergy's platform technology utilizes the efficient biomechanics of filamentous organisms to produce tunable material properties through a bottom-up approach. The use of a robust biological system also allows for the utilization of waste carbon sources such as industrial wastewater as a renewable feedstock. Ultimately, this process facilitates low cost and sustainable manufacturing of porous carbon materials with select characteristics directed towards specific applications. For example, Emergy can produce low cost, high surface area, pure carbon electrodes for supercapacitors from the treatment of brewery wastewater.

CRITICAL NEED FOR THIS TECHNOLOGY

With a growing global population, there is an ever-increasing demand for carbon-based materials used in applications such as energy storage, filtration, and catalysis. Conventional production of porous carbon materials consumes non-renewable or limited feedstock materials, such as coal, wood, or coconut husks. The development of efficient manufacturing methods, using sustainable feedstocks, and with the smallest energy use and greenhouse gas footprint possible, is needed to meet growing demand without causing environmental and societal harm.

Recently carbon-based nanomaterials have shown unprecedented physical and chemical properties such as high strength, excellent resistance to corrosion and exceptional electrical and thermal conduction and stability. Because of these unique features, carbon-based materials are in high demand for products across many fields. Current manufacturing methods are costly and energy intensive and can have negative environmental impacts. However, those based on energy efficiency and renewable feedstocks provide an alternate approach to carbon-based materials manufacturing with lower cost and environmental impact.

About Argonne National Laboratory

- U.S. Department of Energy research facility
- Midwest's largest federally funded R&D facility
- Located in Lemont, IL, about 25 miles (40 km) southwest of Chicago, IL (USA)
- Conducts basic and applied research in dozens of fields
- 1,600 world-class staff scientists and engineers
- Unique suite of leading-edge and rare scientific user facilities

About Chain Reaction Innovations

- Funding for up to two years
- World-class R&D support at Argonne National Laboratory
- Dedicated laboratory and office space
- Support obtaining additional project funds
- Assistance conducting R&D
- Unparalleled access to an innovation ecosystem

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