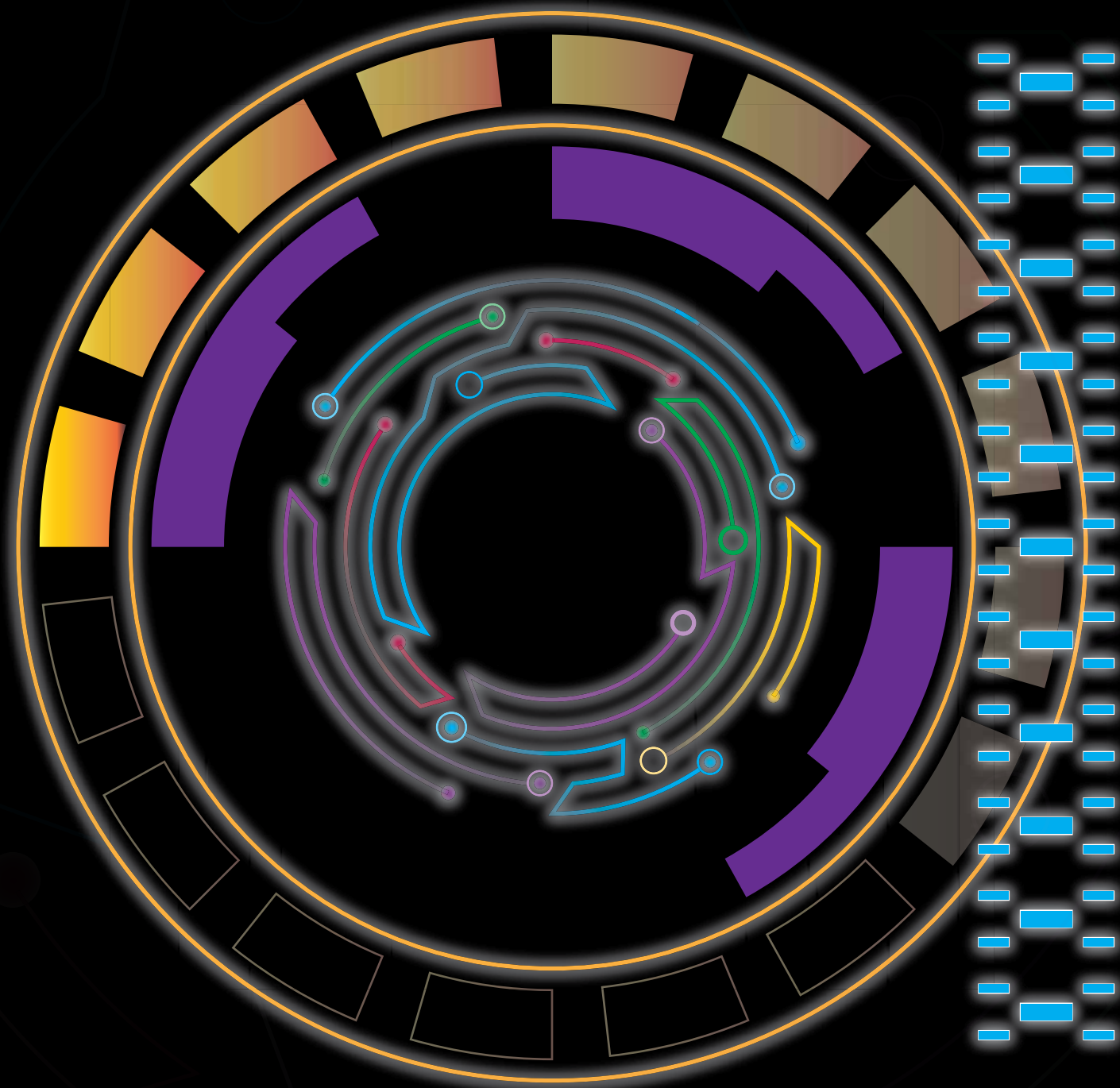


ACCELERATING PARTNERSHIPS FOR COMMERCIAL IMPACT



ECONOMIC INGENUITY THROUGH INDUSTRY PARTNERSHIPS

Innovation is more than **invention**—it is the path from scientific creativity to deployment of a solution for a validated customer need. The Richard P. Feynman Center for Innovation facilitates a broad spectrum of steps along the pathway to technology commercialization, from protecting the Laboratory's portfolio of patents and copyrights to enabling efficient collaborations, partnerships and agreements. This empowers Laboratory staff and external organizations to identify opportunities that lead to new technologies, products and businesses.

For Los Alamos to play a larger role in transitioning its most innovative technologies, we must recognize external trends and investments in private industry and government markets to move our technology development through the Innovation Value Chain that enables effective partnerships and attracts greater private sector interest and investment.



The 2021–22 Progress Report celebrates the power of Los Alamos National Laboratory partnerships to deploy innovations, solve national security challenges and make a positive impact on the country's economic competitiveness.

- **Kalpak Dighe: Entrepreneurial Spirit Award** — Through DisrupTECH and the Entrepreneur Leave of Absence (ELOA) program at Los Alamos, Kalpak is launching a company to produce a modern capacitor, called K-Modules, to replace 40 year old models used in industry.
- **BioGoo: Next Big Idea Award** — Vlad Henzl, Ann Junghans and Rollin Lakis developed BioGoo, a forensic evidence extraction technology with commercial application to support forensic science in law enforcement and forensic labs.
- **Pajarito Powder: Notable New Mexico Start-Up** — Pajarito Powder uses technology licensed from Los Alamos to design and manufacture advanced catalysts vital to hydrogen fuel cell systems in commercial and personal vehicles.
- **Kairos Power: Outstanding Partnership Award** — Kairos Power is developing a novel fluoride high-temperature nuclear reactor. They are leveraging Los Alamos' Low Enriched Fuel Fabrication Facility to aid in fuel fabrication.
- **Advent Technologies Holdings, Inc: Technology Transfer Award** — Through the DOE L'Innovator Consortium, Advent has licensed Los Alamos ion-pair fuel cell technology to manufacture next generation PEM fuel cells in heavy trucks and other vehicles.

Entrepreneurial Spirit

Kalpak Dighe

“Programs like DisrupTECH, TechMat and R&D 100, and direct engagement with FCI’s assigned Business Development Executive (BDE) played a vital role in customer discovery and maturing K-Modules for potential commercialization”

– Kalpak Dighe, KALTRON

Innovation

In the science of national security, an understanding of materials and physical processes is critical. Febetrons generate X-rays or electron beams to photograph objects that are moving at extremely high speeds and enable a variety of measurements. These machines are powered by capacitor modules, which have not been updated in 40 years and are aging, failing and difficult to replace. Kalpak Dighe started his entrepreneurial journey in fall 2021 when he developed a modern capacitor module, called K-Modules.

Kalpak began the Entrepreneur Leave of Absence (ELOA) program to commercialize the K-Module technology for both commercial and NNSA core mission customers. As part of this program, he assessed market and customer needs for K-Modules through DisrupTECH and a Technology Maturation Investment. Kalpak also submitted an R&D 100 Award application, which he won in 2022.

Technology Advancement

K-modules, a new capacitor module technology, substantially increases the output voltage and power of flash X-ray devices. This additional output voltage increases the X-ray spectra, in other words, the energy of the accelerated photons, allowing the X-rays to penetrate farther through material. The higher X-ray dose results in clearer radiographs of dense objects moving at extremely high speeds. These radiographic images refine computer models for device behavior under extreme conditions. K-Modules are customizable, easy to replace and repair, and most components are recyclable.

Impact

Through his ELOA experience, Kalpak identified and connected with DoD and DOE customers that utilize flash X-ray radiography, as well as commercial partners in the aerospace industry that leverage electron beam generation. Kalpak launched KALTRON, a New Mexico startup company, and has executed a non-exclusive license to manufacture and sell the patented K-Module technology for commercial and NNSA core mission customers.



Outstanding Partnership

Kairos Power

“Our work with Los Alamos National Laboratory will be the catalyst for Kairos Power to build a credible path to manufacture fuel at industrial scale for KP-FHR technology. I am proud of both teams’ commitment to collaborating in a public-private partnership to bring clean energy to market.”

*– Ed Blandford,
Kairos Power Chief Technology Officer*

Innovation

In support of national clean energy initiatives, Kairos Power is developing a novel fluoride salt-cooled high-temperature nuclear reactor that leverages TRI-structural ISOtropic (TRISO) particle fuel in pebble form. To aid in fuel fabrication for its Hermes demonstration reactor, to be built in Oak Ridge, Tenn., the company executed CRADAs with Los Alamos to leverage the emerging Low Enriched Fuel Fabrication Facility streamlining manufacturing, waste handling and fabrication processes for annular TRISO fuel pebbles.

Technology Advancement

Using their expertise in fuel fabrication, manufacturing process design and reactor safety analysis through the Civilian Nuclear Program, the Los Alamos research team (Dasari Rao, Timothy Coons and Sabrina Hadinoto) is working in partnership with Kairos Power engineers to fabricate and validate TRISO particle fuels, as well as supporting the fluoride salt characterization and heat pipe integration into the reactor. They are using their expertise in fuel fabrication, manufacturing process design and reactor safety analysis through the Civilian Nuclear Program.

The Low Enriched Fuel Fabrication Facility at Los Alamos poses a means to “bridge the gap” between R&D-scale activities and high commercial-scale activities by enabling production of fuel for customers to demonstrate in their reactors.

The TRISO fuels being fabricated in this partnership boast characteristics important to fuel performance, such as resistance to corrosion, oxidation and high temperatures. This enables the fuels to withstand extreme conditions.

Impact

The company is in the process of expanding its engineering center in Albuquerque to further develop its reactor technology. Kairos Power has committed to investing up to \$125 million on the campus and has already created more than 75 high-paying jobs. The proximity to national labs was a primary reason for Kairos Power siting its testing and manufacturing facility in New Mexico.



Next Big Idea

BioGoo

“BioGoo is a product of national security work conducted at the Lab. Through Feynman Center programs, such as DisrupTECH, we were able to find the intersection of science and industry and identify where BioGoo fits in real-world law enforcement agencies and forensic labs.”

– The BioGoo Team

Innovation

Vlad Henzl, Ann Junghans and Rollin Lakis are the core of a research team which created a number of technologies, known as SuiteGoo, for a variety of national security applications. BioGoo, one of the SuiteGoo “flavors” is a forensic evidence extraction technology—and the first with potential commercial application—to support forensic science in law enforcement and forensic crime labs.

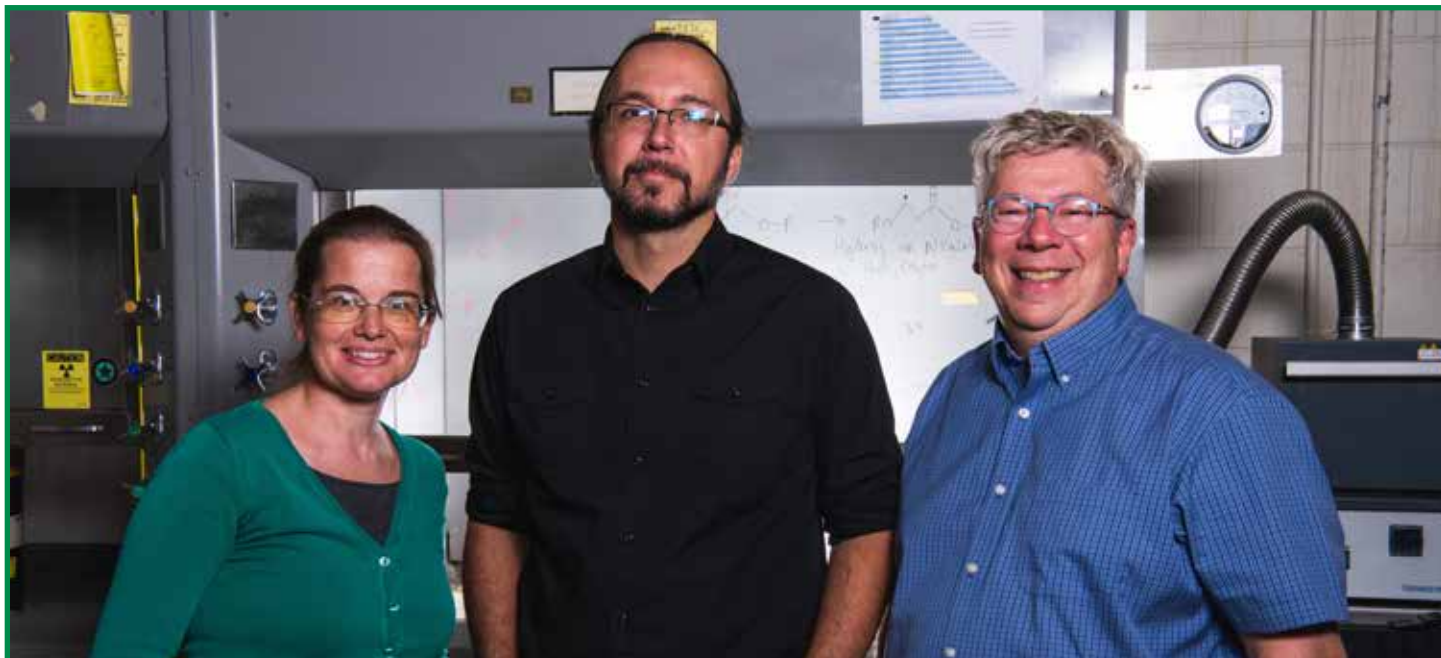
Only one in five crime scene investigations generate enough high-quality DNA to run a good sample analysis that may lead to credible evidence. BioGoo seeks to revolutionize crime scene investigations with high-efficiency forensic sampling that can enable detection of smaller biological traces than currently possible, thus significantly increasing the chances of solving crimes.

Technology Advancement

BioGoo uses a matrix of peelable UV curable coating that collects and extracts DNA and other biological traces from surfaces of interest with greater efficiency than traditional collection methods that use cotton swabs. After applying the liquid UV curable coating to the surface and illuminating it with UV flashlight for a few seconds, BioGoo solidifies and becomes peelable. BioGoo locks in traces of biological material and contamination, which can be extracted and studied with existing chemistry and analysis tools.

Impact

This technology is easy to use, minimizes training requirements and only takes a few minutes to deploy. Additionally, it is not hazardous to users and can be applied to rough or scuffed surfaces where forensic evidence may be most abundant but inaccessible by current methods. The team participated in DisrupTECH and Energy I-Corp Lite to develop their commercialization strategy. The team hopes to develop a partnership that demonstrates the effectiveness of BioGoo in crime scene investigations.



Technology Transfer Excellence

Advent Technologies Holdings, Inc

“The innovation of the L’Innovator is that we get the advantage of working side-by-side with the inventors to move laboratory technology through developmental stages and to a final, manufactured product.”

*– Emory De Castro, Chief Technology Officer of
Advent Technologies Holdings, Inc.*

Innovation

A large portion of national greenhouse gas emissions is from the transportation sector. The DOE L’Innovator Consortium, a partnership between Los Alamos, Brookhaven, the National Renewable Energy Laboratory and Advent, focuses on reducing the tons of greenhouse gases emitted by medium and heavy-duty trucks to help mitigate global climate change. Current technologies have limited potential and are a challenge to apply to a broad customer base.

Since the launch of their partnership with the DOE L’Innovator Consortium in 2016, Advent Technologies, Inc., a subsidiary of Advent Technology Holdings, Inc. (NASDAQ: ADN) has licensed Los Alamos ion-pair fuel cell technology to develop next generation PEM fuel cells for use in reducing CO₂ emissions and increasing mobility capabilities in heavy trucks and other power applications.

Technology Advancement

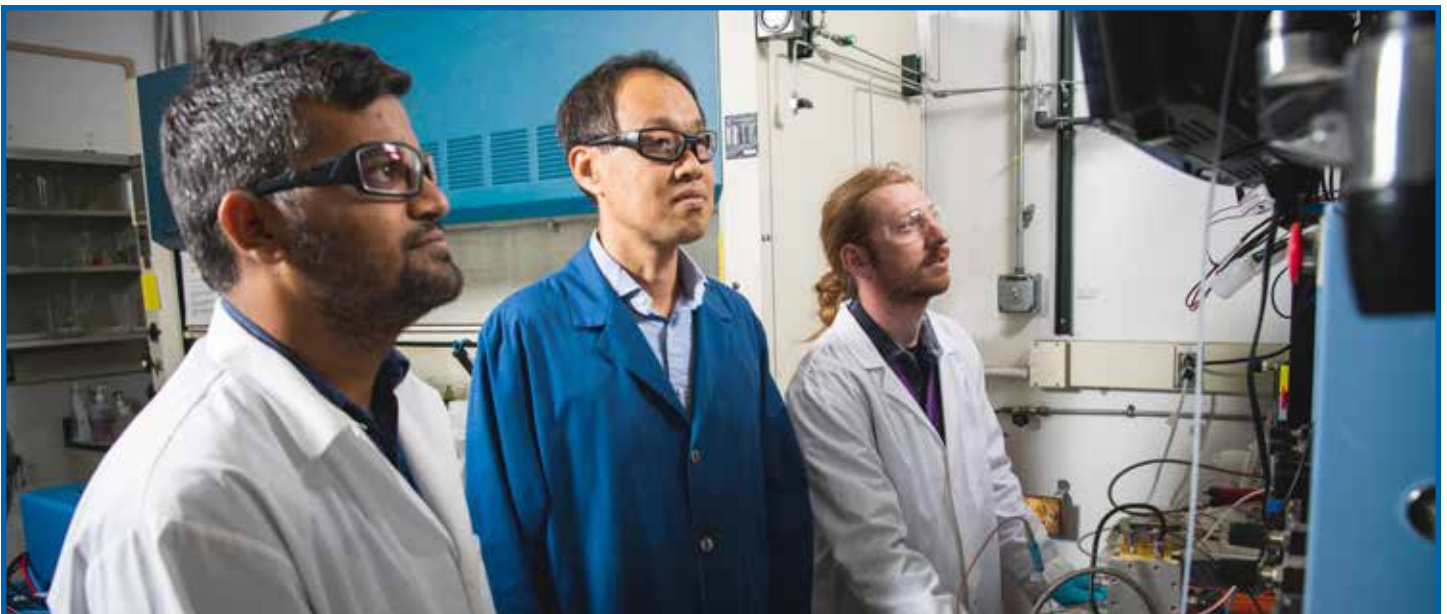
Yu Seung Kim and his team at Los Alamos National Laboratory pioneered 28 inventions pertaining to the ion-pair polymer electrolytes. This material technology is central to membrane electrode assemblies (MEAs) of proton

exchange membrane (PEM) to further develop fuel cell technology. The Los Alamos ion-pair fuel cells run at high power and a variety of temperatures. It is also more independent of water and allows these fuel cells to be used virtually anywhere with nearly any hydrogen carrier fuel.

By delivering power and durability at temperatures well above current vehicle fuel cell technology, it is ideal for the lifetime service demands of heavy-duty trucks. Advent is collaborating with the Los Alamos research team to maximize the power generated by the ion-pair technology and increase its durability—important in hauling heavy loads and achieving reliable power cycling.

Impact

The Los Alamos collaboration enabled Advent to assemble and demonstrate a small-scale stationary fuel cell prototype, Honey Badger 50™, that establishes the high temperature fuel cell compositions. Advent is designing and building a manufacturing center to produce components of the Honey Badger 50™, and other ion pair innovative technology, in Boston, Massachusetts. Advent has recently hired five new employees and anticipates hiring another 35 employees once the company scales into manufacturing.



Notable New Mexico Start-up

Pajarito Powder

“Los Alamos helped us understand how our catalyst materials work and how to improve them. Better materials allow us to expand our customer base and therefore our footprint and workforce in New Mexico.”

– Thomas J. Stephenson, Chairman and CEO

Innovation

Pajarito Powder, a start-up located in Albuquerque, designs and manufactures advanced catalysts used in electrolyzers and fuel cells. The catalyst powder made by Pajarito Powder—using technology licensed from Los Alamos National Laboratory—is central to hydrogen fuel cell systems in commercial and personal vehicles.

Technology Advancement

Novel fuel cell catalyst formulations that reduce cost and improve performance (including stability and durability) are critical to the future growth of clean energy production. The company’s products are based on interconnected carbon support materials that improve the operating characteristics of catalysts.

To improve their product, the company needed additional expertise and facilities to assess performance and durability of the catalyst. In their most recent TRGR project, the company worked with Los Alamos to investigate the degradation process of their catalyst products. This benchmarked the powders’ performance and durability, and also ascertained areas to optimize the catalyst.

Impact

Pajarito Powder was able to use the results and guidance provided by Los Alamos to expand their customer base and deploy their fuel cells globally. They also have been able to hire six New Mexicans in the past six months. The company continues to work with Los Alamos through a second Technology Readiness Project to develop their next-generation catalyst.



METRICS

FY 2021

FY 2022

LICENSES

Active Agreements

439

Funding

\$2.5M

Active Agreements

406

Funding

\$1M

PATENTS

49

Applications

77

Issued

50

Applications

65

Issued

CRADAs

Active Agreements

52

Funding

\$1.7M

Active Agreements

46

Funding

\$2.7M

NFE

Active Agreements

81

Funding

\$14.9M

Active Agreements

76

Funding

\$14.2M