An early stage entrepreneurial fellowship program
at Oak Ridge National Laboratory

INNOVATION CROSSROADS

OAK RIDGE NATIONAL LABORATORY

INNOVATOR SHOWCASE

Spring 2021

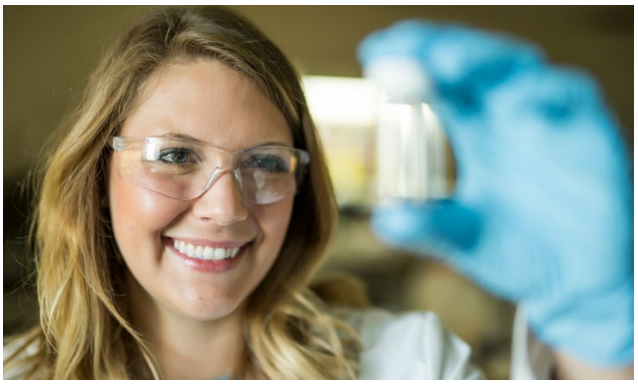
U.S. DEPARTMENT OF ENERGY

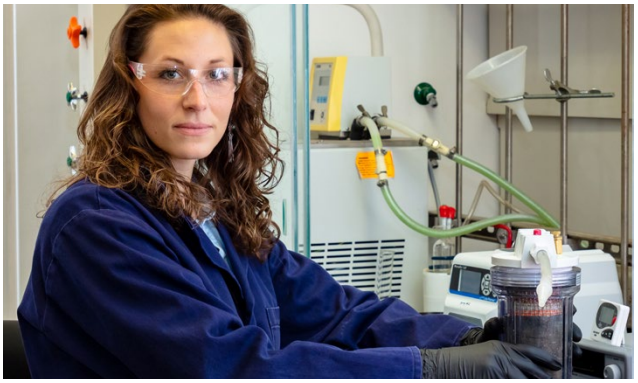
TVA

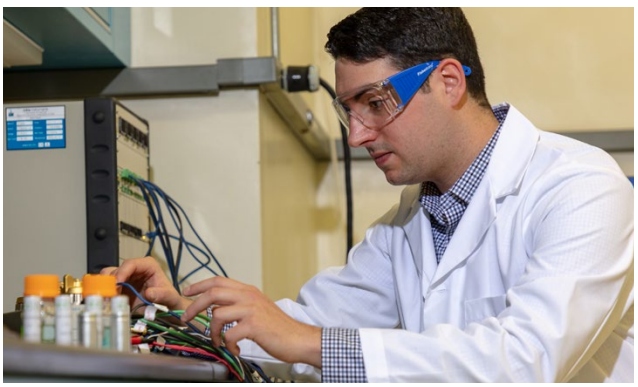
Starting new energy-related technology companies can be challenging, and that's one reason the number of energy startups has declined significantly over the past decade. Innovation Crossroads is a program supported by the U.S. Department of Energy's (DOE's) Advanced Manufacturing Office and the Tennessee Valley Authority (TVA) that leverages Oak Ridge National Laboratory's (ORNL's) unique scientific resources and capabilities and connects the nation's top innovators with experts, mentors, and networks in technology-related fields to take world-changing ideas from research and development (R&D) to the marketplace.

Innovation Crossroads is a two-year program for innovators focusing on energy and advanced manufacturing technologies. Through an annual national call and competitive stage-gate process, top entrepreneurial-minded innovators are selected to join the program. Selected innovators receive a fellowship that includes a personal living stipend, along with health insurance and travel allowance, a substantial grant to use on collaborative R&D at ORNL, and comprehensive mentoring assistance to build a sustainable business model.

By embedding the next generation of top technical talent within ORNL, Innovation Crossroads positions entrepreneurial researchers to address fundamental energy and manufacturing challenges identified by industry.







INDEX

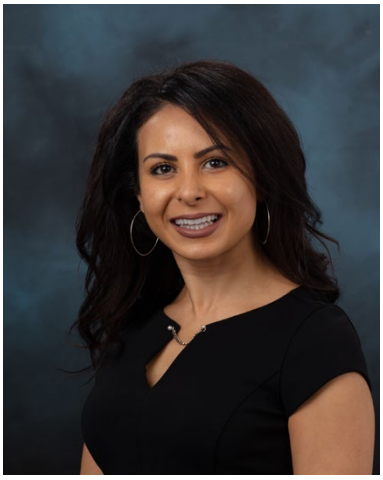
Section 1: Innovative Products - Semiconductors, Cryogenics and Nuclear

Section 2: 3D Printing and Advanced Materials

Section 3: Electrification, Storage, Computing and Security

Section 1

INNOVATIVE PRODUCTS
SEMICONDUCTORS, CRYOGENICS AND NUCLEAR



Danielle Castley
Becq, Founder and Chief Executive Officer

Innovation Crossroads Innovator – Cohort 4

Project Abstract/Company Update

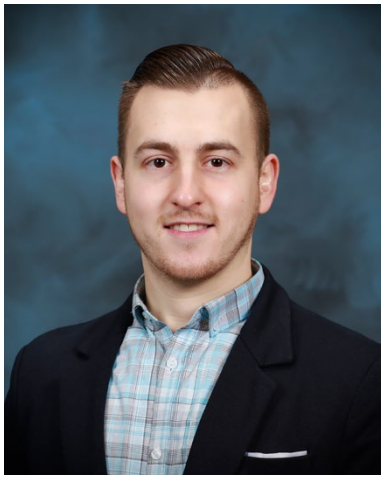
Becq is a radiation shielding materials company whose technology will help to reduce costs and increase safety in the nuclear industry. Becq's core competency is currently neutron shielding technology. Innovation in the neutron shielding market has lagged in the past several decades and Becq's technology is a breakthrough for the field. Becq's initial product offering, NE-300, is a lightweight, high-temperature neutron shielding material. The key differentiation of NE-300 over existing materials is a temperature resistance of 300°C instead of 180°C. NE-300's higher operating temperature introduces significant opportunities for deploying neutron shielding materials in higher-temperature locations within the reactor containment and/or to improve the safety margin in applications originally designed for shielding with a lower operating temperature. While NE-300 currently exceeds the requirements for many applications in the nuclear industry, the Innovation Crossroads program at Oak Ridge National Laboratory will allow Becq to perform the additional development necessary to validate the long-term use of this product and prepare it for commercialization.

Becq's vision is to become first-in-sales in the $1 billion international neutron shield materials market over the next decade by becoming the dominant supplier to the commercial nuclear industry and expanding into the defense and space markets. Becq has the long-term goal of becoming the largest radiation shielding company and one of the largest materials suppliers in the world.

Bio

Danielle Castley is developing a high-temperature, lightweight neutron-shielding technology that will help reduce costs and increase safety in the nuclear industry. This technology operates at a higher temperature than existing polymer-based neutron-shielding products. The higher temperature resistance of 300°C instead of 180°C introduces significant opportunities for deploying neutron shielding materials in higher-temperature locations within the reactor containment and/or to improve the safety margin in applications originally designed for shielding with a lower operating temperature. Castley holds a PhD in Materials Science and Engineering from Dartmouth College and is the founder of Becq.

CONTACT: **dcastley@becqtech.com**



Shane McMahon
Lux Semiconductors, Co-Founder and Chief Executive Officer

Innovation Crossroads Alumni – Cohort 2

Project Abstract/Company Update

Lux Semiconductors can significantly improve the performance of large area, thin-film semiconductors through a patent pending recrystallization process. By leveraging a century of innovations in bulk crystal growth and applying them to low cost thin-films for the first time, Lux will deliver an entirely new class of flexible semiconductors to serve as a next generation material platform for integrated electronics. The platform will be suitable to host a range of electronic components and fully integrated system-on-chip designs including sensors, RF, displays, lighting, processors, memory, micro-electro-mechanical systems (MEMS), energy harvesting, and similar 'internet of things' devices. The company was founded in April 2017 by Dr. Shane McMahon, CEO, and Dr. Graeme Housser, CTO. The company is co-located at Oak Ridge National Laboratory, in Oak Ridge, TN and at the SUNY Polytechnic Institute in Albany, NY. Lux is developing and commercializing technology spawned from PhD research conducted on behalf of the founders during their tenure at the SUNY Polytechnic Institute. Lux has raised significant non-dilutive funding including, National Science Foundation SBIR Phase I and Phase II awards, a Department of Defense Air Force Research Laboratory SBIR Phase I and II awards. Lux has also received funding from NEXUS-NY, RIT Venture Creations, and the Techstars Starburst Space Accelerator.

Bio

Shane McMahon is developing thin-film semiconductor substrates that will serve as a novel platform for highly integrated and flexible electronic devices. The platform will provide the ability to integrate core Internet of Things (IoT) functionality, including sensors, logic, memory, communication, and power. Shane holds a PhD in Nano-Engineering from the State University of New York at Albany.

CONTACT: **smcmahon@luxsemiconductors.com**

Jesse Claypoole
MantaPoole Technologies, Founder and Chief Executive Officer

Innovation Crossroads Innovator – Cohort 3

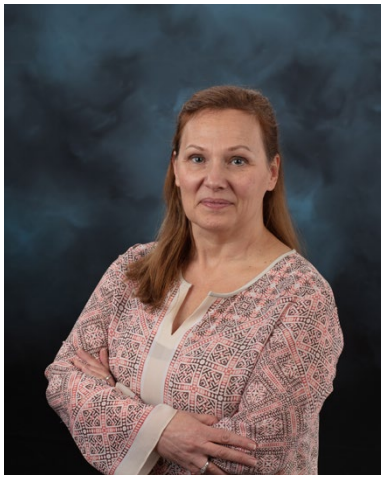
Project Abstract/Company Update

With the development and proliferation of smart machines that can increasingly autonomously interact with the real work, it is important that these smart machines be increasingly able to make decisions based on real world variables. To make these decisions, these smart machines will need the correct amount and type of information and essentially the capabilities of these smart machines are limited by the capabilities of their sensors. In order to address this problem, MantaPoole technologies is developing a next generation imaging solution that can enable machines to see the "what" and "where" of their application in a single camera form factor. This advanced capability is enabled by the novel optical system MantaPoole Technologies is developing called Plenoptics 3.0. Plenoptics 3.0 will enable the capture of both spectral and depth information without a reduction of the image quality. This advanced imaging solution will enable smart machines to tell what an object is made of, its shape, and where it is.

Bio

Mantapoole is developing a roll-to-roll, manufactured, active multispectral light field (AMLF) micro-optics architecture for applications including autonomous surgery, industrial manufacturing, robotic farming, and real time robot vision. Jesse earned a PhD in Nanoscale Science at the State University of New York Polytechnic Institute.

CONTACT: **mantapooletechnologies@gmail.com**



Renee Carder
PixelEXX Systems, Co-Founder and Vice President

Innovation Crossroads Innovator – Cohort 4

Project Abstract/Company Update

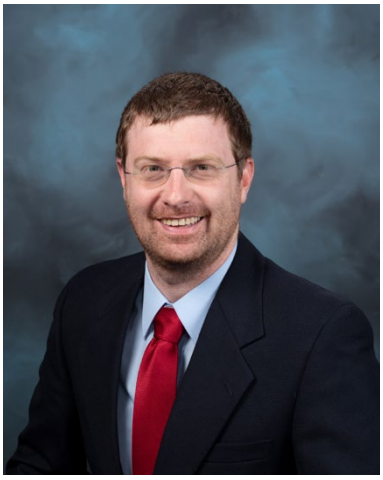
Photon detection is a great enabler of pure and applied science with broad reaching benefits. It is not only central to the exploration of the fundamental nature of energy, matter, space and time, but also plays an important role in applications such as light/laser detection and ranging, photography, astronomy, quantum information science, medical imaging, microscopy, and communications. Today, the performance of different classes of photon detectors varies in 1) noise characteristics which sets a floor on the minimum signal intensity that can be observed; 2) saturation characteristics which sets a ceiling on the maximum signal intensity that can be observed; and 3) geometric, absorption and signal conversion characteristics that determine the proportion of the incident signal that can be measured. The company is working with Oak Ridge National Laboratory to address these critical performance limitations using of a new class of solid-state photomultipliers that exploit optical resonances in semiconductor materials to enhance light absorption and detection. When combined with the ability to generate a large output signal via internal avalanche multiplication, such sensors would significantly improve photon detection and counting with high resolution and with single photon sensitivity. Initial applications will focus on devices used with scintillation detectors, essential instruments in a variety of fields, serving as an effective means of detecting radiation for industrial, defense, medical, and basic-research applications.

Bio

PixelEXX Systems is reimagining tomorrow's cameras so you can capture, analyze, and interpret the world around us in awe inspiring detail. Ninety percent of the information we process is visual and we process it 60,000 time faster than text. Thus, it is not surprising that the review and analyses of visual data is critical to enterprises across all industries. The technology can be found in everything from self-driving cars and drones to medical imaging devices and robots. Smart cameras combined with visual technology will reduce errors, improve production efficiency, combat fraud, and enhance our daily lives. Using nano-sized pixels to collect more light, PixelEXX high performance image sensors and cameras will deliver higher resolution, better sensitivity and dynamic range, and enhanced color—all in an unprecedented form factor.

Renee is a visual neuroscientist with deep experience in designing imaging-based experiments and analyzing the subsequent data to extract complex information. She holds a PhD in Neurobiology, Anatomy and Cell Science, and Neuroscience from the University of Pittsburgh Medical School.

CONTACT: **rcarder@pixelexx.com**



Trevor McQueen
Neptune Fluid Flow Systems, Co-Founder and Chief Executive Officer

Innovation Crossroads Innovator – Cohort 3

Project Abstract/Company Update

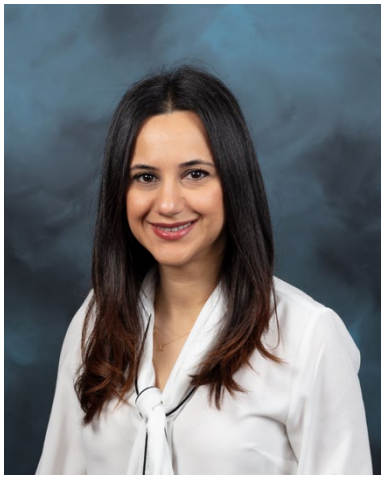
As a society that believes in a better future, we constantly seek new ways and new methods to improve our healthcare and manufacturing capabilities. Over the years, the U.S. has invested trillions of dollars in areas of development such as the discovery of new drugs and therapeutics to lengthen and enrich our lives, and the synthesis and characterization of new materials to build more energy-efficient buildings and safer consumer products. To continue pushing beyond our limits to achieve greater things, we need to understand how life and materials behave at a fundamental level. We need to provide researchers the necessary analytical tools to learn about the structure of biomolecules and other soft matter materials, which make up the basis of the world around us, so that they can make life-changing discoveries in lab.

Neptune Fluid Flow Systems LLC is a scientific hardware startup founded in 2016 by Dr. Trevor McQueen to improve the sample preparation, handling, and delivery processes for scientific research. Neptune's current mission is to assist structural biologists and material scientists by making cryo-transmission electron microscopy (cryo-TEM) a reliable, reproducible, and repeatable way to visualize and study the three-dimensional soft material structures to advance drug design and advanced manufacturing industry in the U.S.

Bio

Neptune Fluid Flow Systems is developing an advanced thin film cryogenic sample preparation device designed to substantially improve sample preparation for the transmission electron microscopy (TEM) community. Trevor earned a PhD in Chemistry from Stanford University.

CONTACT: **neptuneffs@gmail.com**



Leila Safavi
Purist, Co-Founder and Chief Executive Officer

Innovation Crossroads Innovator – Cohort 3

Project Abstract/Company Update

Medical radioisotopes are time sensitive radioactive ingredients that are used for diagnosis and treatment of life-threatening diseases such as cancer. In recent years the availability of these ingredients has become a source of concern due to dependence on a limited number of aging production facilities worldwide. To overcome this concern and meet the growing demand for medical radioisotopes, Purist is developing a technology to enable a distributed network of small-scale and underutilized nuclear reactors produce high purity radioisotopes. Purist will complement the efforts of existing production facilities to serve the current and growing demand of the medical radioisotope market, increase domestic radioisotope production capabilities, and work towards ensuring

---

Bio

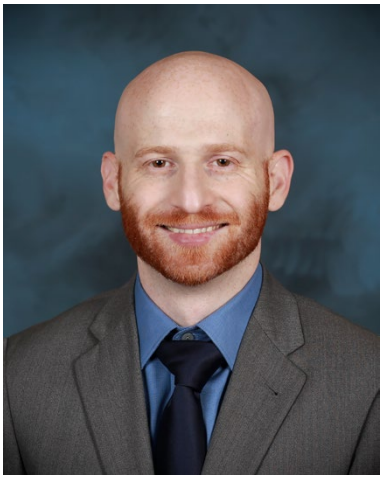
Leila is the Co-Founder and Chief Executive Officer of Purist, a company based on a technology she co-invented during her PhD studies. Purist's focus is developing a technology to be implemented in existing nuclear reactors to produce medical-grade radioactive ingredients. These radioactive ingredients are time-sensitive materials used daily to treat and diagnose life-threatening diseases such as cancer. Leila earned her PhD/MS in Chemical and Biochemical Engineering and BS in Chemistry, all from the University of California, Irvine (UC-Irvine). During her time at UC-Irvine, she became a licensed nuclear reactor operator by the U.S. Nuclear Regulatory Commission and maintained this license for over five years. In 2017, Leila co-founded Purist with her former PhD advisor Dr. Mikael Nilsson and was appointed as CEO. In this role, she has won first place in the 2017 UC-Irvine New Venture Business Plan competition, been the recipient of the 2018 Orange County Engineering Council's Project Achievement award, and the 2018 Best Female Owned Business award from the UC-Irvine ANTrepreneur Center. In February of 2021, Leila was selected to be in the first class of 250 entrepreneurs for Forbes's NEXT 1000 list.

In 2019 Purist was awarded a Small Business Innovation Research (SBIR) grant from the National Institutes of Health. The SBIR award, combined with the ORNL's Innovation Crossroads program, has provided funding and resources to accelerate Purist's technology towards commercialization.

CONTACT: **leilasafavi@puristtechnologies.com**

Section 2

3D PRINTING AND ADVANCED MATERIALS



Justin Nussbaum
Ascend Manufacturing, Founder and Chief Executive Officer

Innovation Crossroads Alumni – Cohort 2

Project Abstract/Company Update

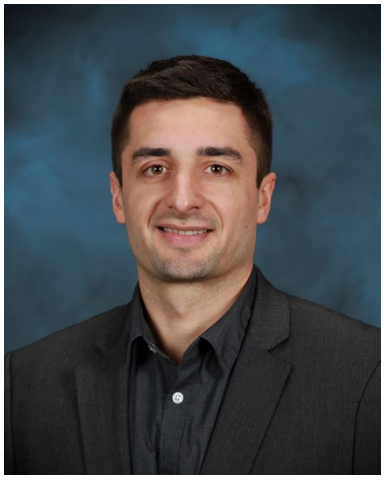
The manufacturing industry in the US today is a massive $2.3 trillion dollars. Manufacturing provides the backbone to our nation in which all other industries benefit from and rely on. As our manufacturing capabilities are improved, our nation can provide faster, cheaper and higher quality parts/services while achieving economic competitiveness to keep manufacturing and all of its jobs at home. One such technology which is driving this charge is additive manufacturing (aka 3D printing). Many times, additive manufacturing can decrease prototyping costs and timelines by over 90% over traditional methods. The nation is moving towards the fourth industrial revolution where agile manufacturing provides the ability to create components on-demand when they are needed, eliminating logistical nightmares behind stock piling large quantities of parts for the future and freeing up capital invested in inventory. While current additive manufacturing technologies can address this issue due to their ability to create components without molds, none have the production speed, quality, or economic price point to satisfy this need.

Ascend Manufacturing designs and fabricates novel industrial additive manufacturing equipment, born from industrial need. Their patented (one granted, five pending) technology is the first technology to truly enable the agile manufacturing industry 4.0, perfectly supplementing existing manufacturing technologies. The new technology used in these systems are being perfected by the founder through collaboration with Oak Ridge National Laboratory, the University of South Florida, and Brigham Young University. These systems are capable of producing injection molded quantities of parts overnight (up to 250,000 parts per day from each machine) without any molds, decreasing turnaround times from months to days and removing the tens to hundreds of thousands in startup costs to create that mold. Additionally, the flexible systems can process materials that are 10X cheaper than what competitors use or high-performance polymers for our aerospace and defense customers. Lastly, they are the one and only company that can fully integrate quality control and quality assurance measures where every part is "born certified" without spending any additional time or money to qualify them. The company is currently seeking additional investors to join a growing pool of investors in a $2.5M seed raise.

Bio

Ascend Manufacturing is focused on developing a manufacturing grade additive manufacturing system, utilizing a technology he developed, called Large Area Projection Sintering (LAPS). LAPS offers many advantages over new and traditional additive manufacturing technologies. With LAPS, components can be economically created with drastically increased production rates, process a broader range of materials, provide superior mechanical properties, all while fully integrating quality control and assurance measures. Nussbaum completed his PhD in Mechanical Engineering at the University of South Florida and is now the Founder and Chief Executive Officer of Ascend Manufacturing.

CONTACT: **justin@Ascendmanufacturing3d.com**



Matt Smith
TCPoly, Co-Founder and Chief Executive Officer

Innovation Crossroads Alumni – Cohort 2

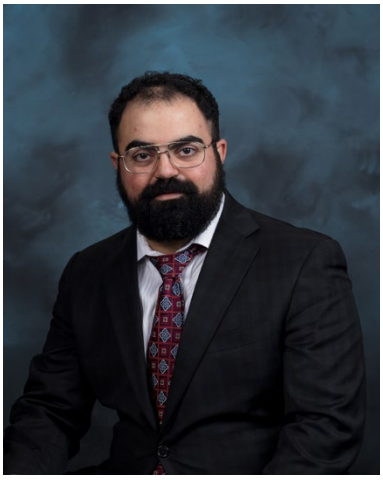
Project Abstract/Company Update

TCPoly is an advanced materials company that has developed high thermal conductivity 3D printing filaments and use their patented materials to fabricate thermally conductive tooling, heat exchangers, and other thermal management devices. TCPoly's vision is to enable high volume 3D printing manufacturing by combining the design freedom of low-cost FDM production with their functional materials to produce new, value-add products. As 3D printing technology continues to mature, TCPoly will leverage IP in materials, thermal products, and printing hardware and software to enable companies to own the manufacturing process and farm 3D print their own functional products.

Bio

Matt Smith's new class of high thermal conductivity plastic composite materials aim to improve heat dissipation, allowing for metal replacement and light-weighting, cost and component reductions, and improved performance and reliability. These materials also exhibit the unique ability to be 3D printed, allowing thermal engineers to rapidly and inexpensively prototype multi-functional thermal solutions and enabling the design of heat transfer products that cannot be manufactured using traditional methods. He holds a PhD in Materials Science and Engineering from the Georgia Institute of Technology and is Co-Founder and Chief Executive Officer of TCPoly.

CONTACT: **matt.smith@tcpoly.com**



Hicham Ghossein
Endeavor Composites, Founder and Chief Executive Officer

Innovation Crossroads Innovator – Cohort 3

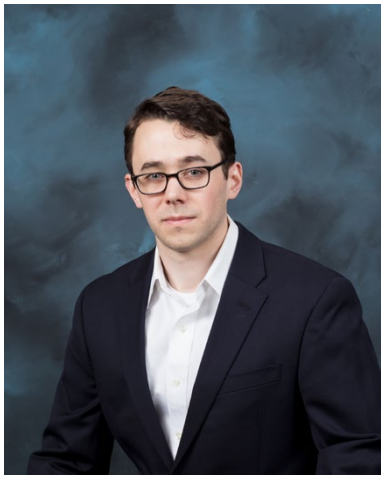
Project Abstract/Company Update

Endeavor Composites, Inc. was founded based on technology exclusively licensed from the University of Tennessee, Knoxville (UTK) and is implementing an innovative mixer system for the hydroentanglement process that offers several advantages over the current fiber dispersion techniques. The innovation evolved around the ability to disperse long (one to one and half inch) carbon fiber (CF) to produce, in a continuous scale, defect free non-woven mats and preforms with excellent quality control (density std. deviation bellow 3%).

Bio

Endeavor Composites is designing and implementing an innovative mixer system for the hydroentanglement process that offers several advantages over the current fiber dispersion techniques. Hicham earned a PhD in Mechanical Engineering from the University of Tennessee, Knoxville.

CONTACT: **hghossein@endeavorcomposites.com**



Will Fitzhugh
American Nanotechnologies, Founder and Chief Executive Officer

Innovation Crossroads Innovator – Cohort 3

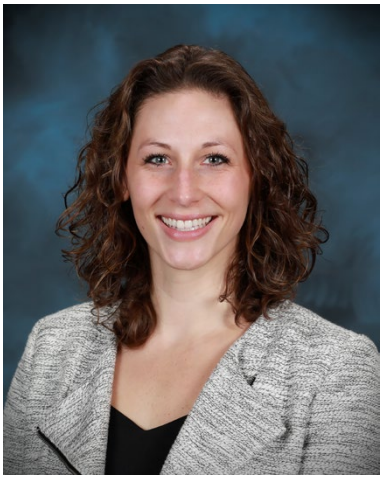
Project Abstract/Company Update

Nanomaterials, such as carbon nanotubes, have been a major focus of R&D for next-gen electronics over the past two decades. Despite remarkable performance of such devices in laboratory settings, commercialization has been hampered by the lack of an economically viable supply chain for the underlying nanomaterials. Many of these materials can be synthesized at industrial scale but require post-synthesis purification that cannot be performed cost-effectively. American Nanotechnologies' breakthrough processing technology will finally close this gap, allowing these remarkable devices to final transition out of the lab and into commercial adoption.

Bio

American Nanotechnologies, Inc. (ANI) is developing material processing technology for purification of high-value nanomaterials. Such material processing technology is critical to developing viable supplies supply chains for next-gen electronics. ANI was founded by Will Fitzhugh who received his PhD in Applied Physics from Harvard University.

CONTACT: **fitzhugh@americannano.tech**



Megan O'Connor
Nth Cycle, Co-Founder and Chief Executive Officer

Innovation Crossroads Alumni – Cohort 2

Project Abstract/Company Update

Demand for critical minerals to power the energy transition is growing exponentially. Yet, we know mining deeper and broader, and building landfills higher and wider, works against our fight to save the planet. At Nth Cycle, they see the path forward and believe all the critical minerals needed for the energy transition are already in circulation today. The company has now developed a clean and profitable way of retrieving them.

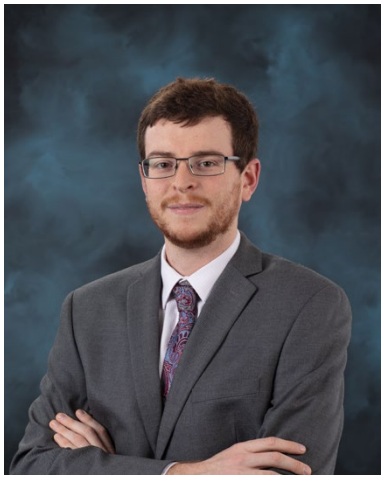
At Nth Cycle, they are taking a different approach to expanding the supply of critical minerals for the clean energy revolution. The team leverages the power of electro-extraction: clean and modular technology for reliably recovering critical minerals from e-waste and low-grade mine tailings using electricity.

Nth Cycle works with battery recyclers and miners. Their customizable and clean electro-extraction technology installs onsite to recover critical minerals from separated e-waste, low-grade ore, and mine tailings. They are the heart of metals processing—the crucial step that profitably separates critical minerals from other elements, transforming them into production-grade feedstocks for the clean energy transition.

Bio

Megan O'Connor is an environmental engineer and chemist who has 7 years' experience in developing carbon nanotube membrane separation technologies. Megan developed the unique hard-tech that uses electro-extraction to turn battery recycling waste streams into profitable commodities. Nth Cycle outputs are metal hydroxides that can be sold to hydrometallurgical refineries for reuse in lithium-ion cathode manufacturing lines. She holds a PhD in Civil and Environmental Engineering from Duke University and is Co-Founder and Chief Executive Officer of Nth Cycle.

CONTACT: **oconnor@nthcycle.com**



Joe Fortenbaugh
Actinic, Co-Founder and Chief Executive Officer

Innovation Crossroads Innovator – Cohort 4

Project Abstract/Company Update

Actinic specializes in bringing new thermally cured thermosets to the 3D printing market. They take commercially available materials, reformulate them, and develop the formulations for use in 3D printing. These formulations are capable of extremely rapid heating/cooling cycles (sub microsecond), which allows for the materials to be 3D printed. Actinic is currently expanding their material portfolio and developing a custom-built 3D printing system. This would be particularly significant for the Department of Defense (DOD) and industrial applications where manufacturing at point of use will be critical for solving prototyping, supply chain, and logistical challenges.

Bio

Joe Fortenbaugh is designing, developing, and testing formulations of thermally cured thermosets which can directly and rapidly produce cured composite thermoset materials upon photothermal heating. This type of heating can be used to bring rapid, on-demand curing to a wide range of thermally cured thermoset polymers. The goal is to develop silicone and epoxy resin formulations for use in additive manufacturing using carbon fiber, ceramics, graphene, metals, and metal oxides fillers. Joe holds a PhD in Chemistry from Penn State University.

CONTACT: **joe@actinic3d.com**

Section 3

ELECTRIFICATION, STORAGE, COMPUTING AND SECURITY

Jesse Thornburg
Grid Fruit, Co-Founder and Chief Executive Officer

Innovation Crossroads Innovator – Cohort 3

Project Abstract/Company Update

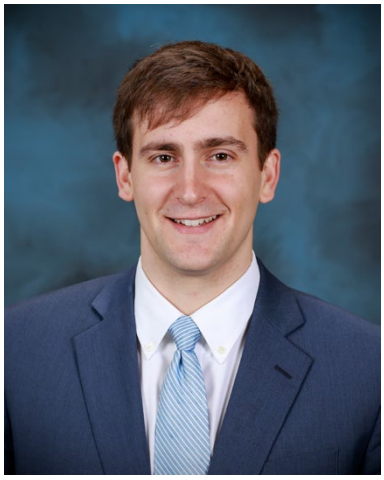
Grid Fruit uses artificial intelligence (AI) and data to keep food fresh while reducing the energy needed for commercial refrigeration. The technology simultaneously procures savings for food retailers and provides grid services for electrical utilities.

Grid Fruit evaluates and then improves the performance of refrigeration systems in terms of energy and food quality. They plan to leverage this information for intelligent asset management including fault detection and predictive maintenance. Grid Fruit will also improve performance of refrigeration systems by providing custom operational recommendations. Finally, with better monitoring and control the technology will be able to leverage thermal storage capacity of retailer refrigeration systems as energy storage (thermal batteries) for the grid.

Bio

Grid Fruit is developing and evaluating a novel technology and operating framework for monitoring and control of commercial refrigeration systems installed at food retailers. Jesse earned a PhD in Electrical and Computer Engineering from Carnegie Mellon University.

CONTACT: **jesse.gridfruit@gmail.com**



Mitchell Ishmael
Active Energy, Co-Founder and Chief Executive Officer

Innovation Crossroads Alumni – Cohort 1

Project Abstract/Company Update

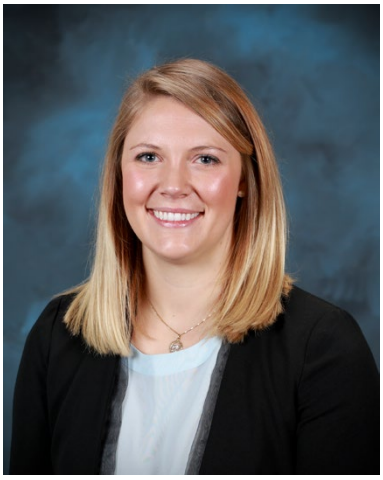
Active Energy is commercializing a new form of energy storage that is clean, economical, and long-lasting. By harnessing the abundant amount of low-temperature (120–160 °F) waste heat generated onsite by the commercial and industrial sectors, they offer customers the ability to produce electricity when it is most costly. Recharging during off-peak, the innovations in phase change materials and heat transfer equipment allow them to achieve round-trip electric efficiencies greater than conventional energy storage. As such, they provide low-cost energy storage to producers of low-grade waste heat, capturing hundreds of GWs of unused energy in the U.S., enabling a cleaner future.

Bio

Active Energy is developing a heat exchanger for a new electro-thermal energy storage system, which will utilize low level waste heat to provide a low-cost, high performance alternative to battery storage. Current target markets include the nation's fast-growing data center industry. Mitch is an east Tennessee native, born and raised in Knoxville. He earned a PhD in Materials Science and Engineering at Cornell University.

CONTACT: **mitch@activeenergysystems.com**

ELECTRIFICATION, STORAGE, COMPUTING AND SECURITY



Anna Douglas
SkyNano Technologies, Co-Founder and Chief Executive Officer

Innovation Crossroads Alumni – Cohort 1

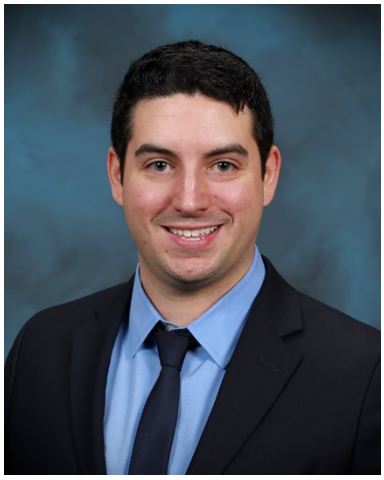
Project Abstract/Company Update

Carbon nanotubes have long been touted as the super material that would change the world, with applications ranging from energy, electronics, automotive, aerospace, and medical. However, they have thus far achieved limited commercial success due to their high price, which is a result of the energy intensive limited-scale manufacturing methods currently deployed, which often have environmentally harmful by-products. SkyNano has developed an electrochemical manufacturing technology to produce carbon nanotubes in a scalable ambient pressure system, and uses only inputs of CO_2 and electricity, resulting in low operating expenses and no toxic by-products. This technology will enable new products and applications due to the low-cost and scalable nature of the technology. Further, SkyNano's technology represents a significant feat in the economical viability of CO_2 utilization, with the introduction of a high-value product produced from CO_2 inputs. Since graduating the Innovation Crossroads program, SkyNano's technology has been supported by the National Science Foundation (NSF), Department of Energy's (DOE) Vehicle Technologies Office and Office of Fossil Energy, and a few initial customers.

Bio

SkyNano is developing a scalable process for making carbon nanotubes, a super-material widely desired in many markets but constrained by high production costs. The process utilizes only carbon dioxide as a feedstock gas and doesn't rely on energy-intensive techniques currently used by competitors. Anna earned her PhD in Interdisciplinary Materials Science at Vanderbilt University.

CONTACT: **anna.douglas@skynanotechnologies.com**



Don DeRosa
Eonix, Founder and Chief Technology Officer

Innovation Crossroads Alumni – Cohort 2

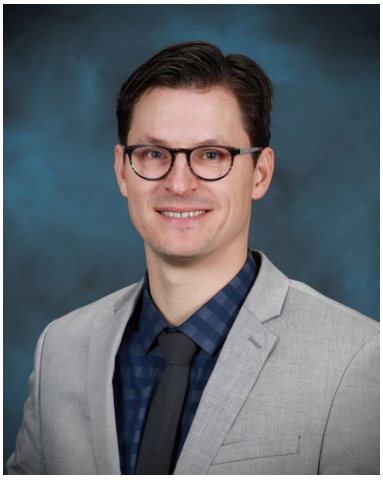
Project Abstract/Company Update

Eonix was originally spun out of the College of Nanoscale Science and Engineering (CNSE) to explore the commercialization of 21 novel ionic liquid electrolytes for ultracapacitors developed through a series of New York State Energy Research and Development Authority (NYSERDA) grants. After receiving a National Science Foundation (NSF) i-Corps award to explore the market potential of these electrolytes, they discovered that ultracapacitor device manufacturers were hampered far more by cost rather than device performance, contrary to the claims in academia. These concerns regarding ultracapacitor device cost were echoed in the interviews later conducted with representatives at automotive OEMs. Despite the automotive performance advantages offered by ultracapacitors and demonstrated in the Chinese hybrid bus and European start stop markets, ultracapacitors would not be adopted for hybrid and electric vehicles by domestic automotive companies without a significant reduction in cost and size. At the conclusion of i-Corps, Eonix was awarded a $250k NYSERDA grant to further study different electrolyte solutions on the benchtop and prototype scale. By leveraging the diverse characterization resources available at the CNSE, Eonix observed the impact of different electrolyte compositions on the degradation of these devices when exposed to a larger potential window. A novel salt that reduced device resistance by 40% was developed during this project. Eonix now aims to leverage this highly conductive salt to develop an electrolyte that expands the potential window of ultracapacitor devices from 2.7V to 3.5V.

Bio

Don DeRosa is developing a next generation electrolyte that will significantly lower the cost and size of ultracapacitor modules. The resulting lower cost and smaller ultracapacitor modules can be used in tandem with lithium-ion batteries to dramatically improve the efficiency, range, and longevity of hybrid and electric vehicles. He received his PhD in Nanoscience from the State University of New York at Albany.

CONTACT: **dderosa@eonixenergy.com**



Alex Lewis
Electro-Active Technologies, Co-Founder and Chief Executive Officer

Innovation Crossroads Innovator – Cohort 3

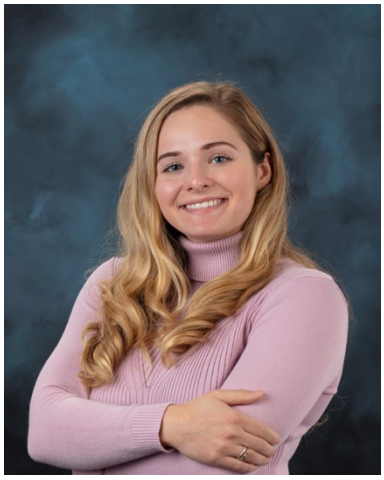
Project Abstract/Company Update

Electro-Active Technologies is developing a process known as microbial electrolysis, which leverages a robust microbial community that grows as a biofilm on an electrode and can actually produce electrons and protons directly from almost any organic waste stream. The protons and electrons produced by the microbes, in addition to about 1 V of additional electricity, are used to make hydrogen separately in the system with high efficiency and purity. This technology can enable companies, waste haulers and municipalities to reduce waste while producing low-cost zero emission fuel in the form of hydrogen. As a company they have received $2.1M in funds mainly from private investment and have also participated in a number of accelerators to advance the business, technical, and manufacturing readiness level of the company, scaling up more than 100-fold over the last 2 years. They are taking a stack approach to scale-up, similar to battery and fuel cell stacks, utilizing smaller units and replicating them to make larger systems, minimizing risks on the biology side. Electro-Active currently have a beta-prototype tested for the target performance and are in the planning stages on two pilots that will contain commercially sized reactor units, enabling them to move rapidly to commercial scale through unit replication and manufacturing after pilot demonstrations.

Bio

Electro-Active Technologies was spun out of ORNL in 2017 and has gone through multiple accelerators in addition to Innovation Crossroads including IndieBio, Plug and Play, H_2 Refuel and MCorps/Scale 4 ClimateTech. The company is developing a modular system for converting food waste and electricity into low-cost, green hydrogen. Alex earned a PhD in Energy Science and Engineering from the University of Tennessee, Knoxville.

CONTACT: **alewis@electroactive.tech**



Erica Grant
Quantum Lock Technologies, Founder and Chief Executive Officer

Innovation Crossroads Innovator – Cohort 4

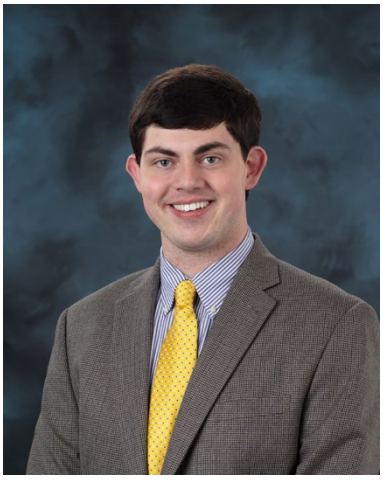
Project Abstract/Company Update

Connected devices bring improvements in convenience and efficiency to a business/industry, but every new line of communication offers a point of weakness for cybersecurity attacks. An example is in a manufacturing smart factory where there are entrances that need access control and machines that are given automated tasks. Quantum Lock is creating security for connected facilities and equipment by using quantum physics to tap into the randomness of particle behavior to create completely unpredictable digital keys to facilitate communication between devices. The hardware-software solution connects all equipment and entrances to a centralized hub which encrypts all communication with the quantum digital keys and detects anomalies with a connected ledger.

Bio

Erica Grant has a PhD in Quantum Computation from the University of Tennessee, Knoxville and a BS in Physics from Virginia Tech. At Virginia tech, she was a leader in a service organization dedicated to educating safety and awareness. Through that organization, she met individuals whose stories were moving. In graduate school, she became interested in the DefCon hacking conferences which published seminars on YouTube that demonstrate security weakness in nearly every field. After learning of the weaknesses in smart locks and how they can be exploited, she clearly saw how her knowledge of quantum information could be applied to securing connected devices.

CONTACT: **erica.grant@qlocktech.com**



Tom Foulkes
AquaQuant Laboratories, Founder and Chief Executive Officer

Innovation Crossroads Innovator – Cohort 4

Project Abstract/Company Update

AquaQuant Laboratories Inc. is commercializing scalable nanostructured surfaces to increase the speed (Gflops) and density (Gflops/m^3) of high-performance computation through two-phase, water immersion cooling.

Electronics thermal management requires both nano- and macro-scale perspectives. Thomas Foulkes has researched advanced cooling techniques and electro-thermal co-design to increase the power density of converters for electric vehicles. He founded AquaQuant Laboratories Inc. (AQL) in 2017 to tackle the electro-thermal demands of next generation data centers.

Bio

Thomas Foulkes is deploying the next generation of high-performance central processing units and graphics processing units required to feed the power demand for elastic cloud computing, big data analytics, complex simulations, and artificial intelligence. The technology creates a higher computational density by transferring heat with direct, water immersion cooling across nanoengineered, durable, and scalable hierarchical porous coatings deposited holistically on electronics. Foulkes holds a PhD in Electrical Engineering from the University of Illinois at Urbana-Champaign.

CONTACT: **foulkes@pacergy.com**

innovationcrossroads.ornl.gov

Oak Ridge National Laboratory is managed by UT-Battelle for the US Department of Energy.

ORNL 2021-G00001/aas