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CHANGING WHAT'S POSSIBLE

EVs4ALL—Electric Vehicles for American Low-carbon Living

PROJECT DESCRIPTIONS

Virginia Tech – Blacksburg, VA

Fast-Charging, Wide-Temperature, Low-Cost, Durable Batteries Enabled by Cobalt- and Nickel-Free Cathodes and Cell Engineering - $2,945,000

Virginia Tech will develop fundamentally disruptive electric vehicle batteries using cobalt- and nickel-free cathodes, fast-charging and all-weather electrolytes, and coal-derived fast-charging and high-capacity anodes. The team will use theoretical modeling and advanced materials and cell characterization methods to guide the system-level integration of battery components. The technology's use of earth-abundant, low-cost raw materials significantly mitigates supply chain risks. By eliminating the use of cobalt and nickel in cathodes, the cathode cost will be substantially reduced. Using a coal/carbon/silicon anode will resolve environmental issues of coal waste and can reduce anode cost to a significant degree compared with a graphite anode.

Tyfast Energy – San Diego, CA

High SYmmetric PowER (HYPER) Battery - $2,823,199

Tyfast Energy's project leverages a novel oxide-based anode and high conductivity electrolyte that has been demonstrated for all climate applications. This new combination of electrode material and electrolyte chemistry will enable a high-energy density, < 6 minutes ultrafast-charging battery with > 3,000 cycle life. Tyfast Energy's novel anode with abundant and domestic supply chain has fast lithium transport with demonstrated 15,000 stable cycles operating under <3 mins ultrafast charging conditions. If successful, the anode and electrolyte developed under this project will enable batteries to exceed the EVs4ALL cycle life target, reducing life cycle cost and recycling, enabling a meaningful used EV market, and facilitating deep vehicle-to-grid operations.

The Ohio State University – Columbus, OH

Extreme Fast Charging Batteries with Extended Cycle Life for EVs - $3,876,363

The Ohio State University (Ohio State) has developed a prototype high-power battery technology that can tolerate rapid charging while demonstrating longevity far beyond the current state-of-the-art lithium-ion cells. Ohio State will scale up the prototype by (1) addressing manufacturing challenges in achieving large-format, commercial-quality cells (2) allowing for drop-in compatibility with existing battery components, and (3) optimizing battery performance for cold temperatures. When scaled, the technology can potentially double the usable battery lifetime, reduce pack size, reduce cell and battery cost, and enable rapid charging accelerating the introduction of affordable entry-level electric vehicles.

South 8 Technologies – San Diego, CA

Liquefied Gas Electrolytes for Next-Gen EV Batteries - $3,152,000

South 8 Technologies will develop high-power lithium-ion battery cells with the capacity to charge rapidly using a novel liquefied gas (LiGas) electrolyte technology. The LiGas electrolyte uses non-toxic and non-corrosive gases that are liquefied under moderate pressures and can be contained in standard cylindrical cell cans. The technology has demonstrated excellent performance in conventional graphite/lithium-nickel-manganese-cobalt-oxide cells and offers many opportunities for cost reduction. South 8 Technologies will harness the inherent safety, high power, and low temperature advantages of the LiGas electrolyte in combination with a high-energy, low-cost, and cobalt-free lithium nickel manganese oxide cathode.

Project K – Palo Alto, CA

Optimizing a Potassium-ion Electrolyte for Revolutionary Automotive Batteries - $2,587,618

Project K is developing and commercializing a potassium-ion battery, which operates similarly to lithium-ion batteries. During discharge, potassium ions move from the negative graphite electrode through the electrolyte—a liquid combining organic solvents, conductive salts, and specialty additives—to the positive electrode, which uses a Prussian blue analog. Potassium ions can move through the electrolyte much faster than lithium ions. Additionally, the thermodynamics of the reaction of potassium with graphite allows much higher currents to be applied to the cell. These two fundamental properties of the potassium-ion system allow it to charge much faster than lithium-ion batteries while also enabling operation at reduced temperatures.

University of Maryland – College Park, MD

Fast-Charge, High-Energy-Density, Solid-State Battery - $4,852,733

The University of Maryland (UMD) will increase the charge/discharge-rate capability, energy density, and operating temperature window of solid-state lithium metal batteries. The team will use new mixed ionic-electronic conducting (MIEC) ceramics and processing techniques to fabricate thinner, higher porosity, and thus lower mass (porous/dense) "bilayers" and (porous/dense/porous) "trilayers." The patented 3D ceramic architecture has shown the highest Li-metal cycling rate for solid-state technology (10 milliampere/cm^2) and demonstrated multiple high-energy-density (~300Wh/kg) cells with multiple cathode chemistries and cell configurations. UMD will integrate the MIEC ceramics in new advanced architectures that enable higher gravimetric and volumetric energy densities and integrate cobalt/nickel-free, high-voltage cathodes with advanced, nonflammable electrolytes.

Solid Power Operating – Thornton, CO

High Energy Fast Charging All-Solid-State Batteries - $5,600,000

Solid Power will develop a 3D-structured lithium (Li) metal anode and novel sulfur (S) composite cathode to enable high-energy and fast-charging electric vehicle battery cells. Solid Power's advanced solid-state electrolyte will enable a three-dimensional Li metal anode and S cathode while overcoming the primary challenges for conventional lithium-sulfur chemistry. Solid Power has also developed roll-to-roll processes for Li metal all-solid-state battery (ASSB) cell fabrication, which can be readily deployed to support this project. These combined innovations will lead to a safe, high-energy density (≥ 500 Watt-hour (Wh)/kg), fast-charging, low-temperature performing, and low-cost ASSB cell.

24M Technologies – Cambridge, MA

Low-Cost, High Areal Capacity, Anode-Free Sodium-Metal Batteries Enabled by Solid Electrolytes - $3,198,085

24M Technologies will develop low-cost and fast-charging sodium metal batteries with good low-temperature performance for EVs. 24M's cell design will incorporate (1) its ultra-thick SemiSolid cathode made up of advanced cobalt-free, nickel-free sodium cathode active material, (2) an advanced wide-temperature, fast-charging electrolyte developed using machine learning and automated high-throughput screening technology, and (3) a solid electrolyte-based separator to enable a high-energy density anode-free configuration.

Ampcera – Tucson, AZ

Thermally Modulated Solid-State Batteries for Ultra-Safe Fast-Charging Electric Vehicles - $2,120,120

Ampcera will develop a thermally modulated solid-state battery (TMSSB) incorporating a thermally modulated cell technology (TMCT), developed by EC Power, that was used in conventional lithium-ion (Li-ion) batteries to power buses during the 2022 Winter Olympic Games. The TMSSB comprises a high-capacity silicon anode and a high-voltage, nickel-rich lithium nickel manganese cobalt oxide cathode enabling an energy density of ≥400 Wh/kg. Combining the TMCT with a high ion conducting solid-state electrolyte will enable rapid charging at ambient conditions. The TMCT also enables cold startup times of less than a minute at ambient temperatures of -20°C, making the TMSSB advantageous in cold climates.

Zeta Energy – Houston, TX

Enabling Fast Charging Batteries with 3D Lithium Metal Architectures and Sulfurized Carbon Cathodes - $4,000,000

Zeta Energy's battery design features a three-dimensional lithium (Li) metal anode architecture and class of sulfurized carbon (SC) cathodes to produce stable and safe devices. Zeta Energy will build on these innovations to create a new anode with a high Li content that is also highly accessible and rechargeable and avoids dangerous Li dendrite formation. The complementary physical and chemical features of the cathode and anode will enable transformational high charge rates and long-term stability while also minimizing performance losses at low temperatures. Battery cost is reduced by using inexpensive, abundant materials, such as sulfur and natural gas feedstocks, instead of nickel, manganese, or cobalt, to manufacture electrodes.

Sandia National Laboratories – Albuquerque, NM

Framework for Safety Evaluation of EVs4ALL Batteries - $3,700,000

Sandia National Laboratories (SNL) will develop a holistic safety framework, combining hierarchical material/cell level testing and mechanistic modeling to evaluate the safety of next-generation battery systems. The framework will facilitate a bottom-up understanding of battery safety, enabling battery developers to de-risk promising chemistries from a safety perspective, reduce design iterations, and develop battery systems with a rigorous safety basis. For example, safety assessments early in battery development will analyze the underlying thermo-electrochemical reaction pathways and delineate safety descriptors such as critical thermal runaway temperatures, magnitudes of heat release, and toxicity of reaction products. Based on this data and analysis, SNL will develop a comprehensive physics-informed modeling framework to establish a safety map, spanning the materials to system scale. This collaborative effort will result in clear guidance on critical safety properties that can be used to classify, inform, and accelerate the development of next generation battery chemistries.

National Renewable Energy Laboratory – Golden, CO

Evaluating the Safety of Next-generation Energy Storage Cells - $3,425,000

The National Renewable Energy Laboratory (NREL) will lead a team to assess the risks of next-generation cells from fundamental reaction kinetics to the full battery level. NREL will apply cutting-edge experimental and modeling techniques to build a comprehensive description of the failure mechanisms and risks of cells. The project will establish an understanding of failure mechanisms, reaction pathways, failure modes and effects, revised testing standards, and new capabilities and tools to help de-risk adoption of next-generation cells for commercial applications.