Battery research and development panama city

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Naval Surface Warfare Center, Crane Division (NSWC Crane) continues its collaboration with Purdue University researchers to establish laboratory testing capability, enhance performance, and improve safety of lithium-ion batteries. Since a Cooperative Research and Development Agreement (CRADA) with Purdue was signed in 2018, the Navy and academic teams have launched a lab for testing, conducted unique research, developed modeling and simulation (M& S) techniques, and published nine academic papers on their efforts.

Dr. Kyle Crompton, a Chief Engineer at NSWC Crane, has led this effort since 2017 to build a lithium-ion experimental cell fabrication and testing lab at Crane and collaborate with Purdue for research. Dr. Crompton was a Department of Defense (DoD) Science, Mathematics, and Research for Transformation (SMART) Scholar who leveraged internal NSWC Crane Naval Innovative Science and Engineering (NISE) funding for several years to form this capability.

“It has been exciting setting up the lab and establishing the relationship with Purdue,” says Dr. Crompton. “We’ve had to take some risks, focus on the long-term vision, and pursue the science. The ultimate goal is to produce new knowledge and new information—where people can grab it and grow from it whether they are in the military, academia, or industry. Not only have we published research, but we have data sets that can be leveraged in a public repository.”

Lithium-ion batteries power everyday technologies, from personal electronic devices like cell phones and electric toothbrushes—to larger technologies such as electric vehicles (EVs), large power grid sources, and backup batteries for buildings and facilities. Lithium-ion batteries are popular mobile energy resources due to being lightweight, high energy density, and rechargeable.

NSWC Crane has more than 60 years of history of supporting energy storage systems. For instance, the Airborne and Space Energy Systems Branch, where Dr. Crompton was previously the manager, has capabilities such as system engineering and test and evaluation for aircraft, satellite, and spacecraft energy storage. This includes battery engineering for military systems like fighter jets and missiles.

The U.S. Navy requires rigorous testing of these batteries before their use on DoD systems to ensure full functionality and safety. This rigorous testing process for high-powered lithium-ion batteries can be costly and hazardous.

“Lithium-ion batteries have higher energy density, can store more energy per mass of the battery with up to five times storage capability than legacy batteries—it’s lighter and smaller which is a big advantage,” says Dr. Crompton. “However, with more energy comes a safety challenge.”

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Dr. Crompton says thermal runaway is the main safety concern of lithium-ion batteries.

“It can happen when lithium-ion batteries are abused, and cause a rapid fire or explosion,” says Dr. Crompton. “Mitigation of this safety concern is currently based on extensive testing and containment engineering. Our idea has been to develop and validate a model that can take the place of some testing and therefore, save time and cost. Through the CRADA with Purdue, we’ve made substantial progress building a detailed 3D model that can simulate thermal runaway of lithium-ion batteries. This is has been a lofty goal, with a lot more research and development still needed. In about 4 years’ time though, we have made a lot of progress.”

He says Purdue and NSWC Crane have complementary capabilities for this experimentation and simulation-based research.

“The collaboration has been mutually beneficial; Purdue has modeling and theory expertise and NSWC Crane has unique laboratory testing capability,” says Dr. Crompton.

Dr. Jason Ostanek, an assistant professor at Purdue University and temporary faculty member at NSWC Crane, leads the collaborative research from Purdue’s perspective. He works in the Applied Thermo-Fluids Laboratory with students on a wide variety of projects. Prior to his work at Purdue, Dr. Ostanek was an employee at NSWC Philadelphia Division for several years. He says individual battery cells, when operated within their specified parameters, are not likely to catch fire.