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Each offers distinct advantages based on the specific application, and KraFAB proudly supplies both technologies to […] Aerospace-Grade Reliability: Resin Designs Conductive Materials for Extreme Conditions In the aerospace industry, where precision, reliability, and safety are paramount, materials must meet stringent specifications to ensure performance in extreme conditions. Resin Designs’ line of electrically conductive materials is engineered to meet and exceed the rigorous demands of aerospace applications, offering advanced solutions that comply […] K.R. Anderson is very proud of its Quality Assurance Programs. Many of our customers have K.R. Anderson at the top of their AVL for materials and converted parts specifically because of our quality record. Due to our regular and comprehensive training programs for all employees on process, inspection, and documentation, our quality incentive programs, and mature process standardization and documentation ensure every part is checked at least twice we are able to consistently maintain a 98% rating with all customers and a 95% internal quality rating. K.R. Anderson is one of only a handful of NIST 800-171 compliant materials and fabrication suppliers supporting U.S. defense and government programs. K.R. Anderson is already in the process of updating its security systems to meet the new CMMC security standard. K. R. Anderson, Inc. was established in 1968 as a sales and distribution organization supporting high tech markets in the Silicon Valley. In 1987, K.R. Anderson, Inc. added custom fabrication of materials to its offerings. Form in Place gasketing was a significant addition to the capabilities in 1997. KR Anderson, Inc. and Rocky Mountain based sister company, Krayden, merged into one company in 2013 under the Krayden name. Product lines in common to both companies were now supported by one company, Krayden. K.R. Anderson was spun off as an independent distribution and conversion company for its exclusive lines using the trade name KraFAB. With materials & services to make every part of your project more seamless, and an experienced team to help you, creating fabricated products has never been easier. Share — copy and redistribute the material in any medium or format for any purpose, even commercially. Adapt — remix, transform, and build upon the material for any purpose, even commercially. The licensor cannot revoke these freedoms as long as you follow the license terms. Attribution — You must give appropriate credit , provide a link to the license, and indicate if changes were made . You may do so in any reasonable manner, but not in any way that suggests the licensor endorses you or your use. ShareAlike — If you remix, transform, or build upon the material, you must distribute your contributions under the same license as the original. No additional restrictions — You may not apply legal terms or technological measures that legally restrict others from doing anything the license permits. You do not have to comply with the license for elements of the material in the public domain or where your use is permitted by an applicable exception or limitation . No warranties are given. The license may not give you all of the permissions necessary for your intended use. For example, other rights such as publicity, privacy, or moral rights may limit how you use the material. As our society continues to electrify, the need for batteries to store energy is projected to be huge, reaching to an estimated 2 to 10 terawatt-hours (TWh) of annual battery production by 2030 from less than 0.5 TWh today. With the lithium-ion battery as the dominant storage technology for the foreseeable future, a key constraint is the limited availability of raw materials, including lithium, cobalt, and nickel, essential ingredients of today’s lithium battery. Although Berkeley Lab is actively working to address this constraint, alternative forms of energy storage are also needed. “Lithium batteries face tremendous pressure now in terms of raw material supply,” Prasher said. “We believe thermal energy storage can be a viable, sustainable, and cost-effective alternative to other forms of energy storage.” Thermal energy storage can be deployed at a range of scales, including in individual buildings – such as in your home, office, or factory – or at the district or regional level. While the most common form of thermal energy uses large tanks of hot or cold water, there are other types of so-called sensible heat storage, such as using sand or rocks to store thermal energy. However, these approaches require large amounts of space, which limit their suitability for residences. From liquid to solid and back again To get around this constraint, scientists have developed high-tech materials to store thermal energy. For example, phase-change materials absorb and release energy when transitioning between phases, such as from liquid to solid and back. Phase-change materials have a number of potential applications, including thermal management of batteries (to prevent them from getting too hot or too cold), advanced textiles (think of clothing that can automatically keep you warm or cool, thus achieving thermal comfort while reducing building energy consumption), and dry cooling of power plants (to conserve water). In buildings, phase-change materials could be added to walls, acting like a thermal battery for the building. When the ambient temperature rises above the material’s melting point, the material changes phase and absorbs heat, thus cooling the building. Conversely, when the temperature drops below the melting point, the material changes phase and releases heat. However, one problem with phase-change materials is that they typically work only in one temperature range. That means two different materials would be needed for summer and winter, which increases the cost. Berkeley Lab set out to overcome this problem and achieve what is called “dynamic tunability” of the transition temperature. Shown are two different ways of integrating thermal energy storage in buildings. A thermal battery (powered by a phase-change material) can be connected to a building’s heat pump or traditional HVAC system (left), or the phase-change material can be incorporated inside walls. (Credit: Berkeley Lab) In a study recently published in Cell Reports Physical Science, the researchers are the first to achieve dynamic tunability in a phase-change material. Their breakthrough method uses ions and a unique phase-change material that combines thermal energy storage with electric energy storage, so it can store and supply both heat and electricity. “This new technology is truly unique because it combines thermal and electric energy into one device,” said Applied Energy Materials Group Leader Gao Liu, co-corresponding author of the study. “It functions like a thermal and electric battery. What’s more, this capability increases the thermal storage potential because of the ability to tune the melting point of the material depending on different ambient temperatures. This will significantly increase the utilization of phase-change materials.” Kaur, also a co-author on the paper, added: “In the bigger picture, this helps bring down the cost of storage because now the same material can be utilized year round instead of just half the year.” In large-scale building construction, this combined thermal and electrical energy storage capability would allow the material to store excess electricity produced by on-site solar or wind operations, to meet both thermal (heating and cooling) and electrical needs. Advancing the fundamental science of phase-change materials Another Berkeley Lab study earlier this year addressed the problem of supercooling, which is super not cool in certain phase-change materials because it makes the material unpredictable, in that it may not change phase at the same temperature every time. Led by Berkeley Lab graduate student assistant and UC Berkeley PhD student Drew Lilley, the study, published in the journal Applied Energy, was the first to demonstrate a methodology to quantitatively predict the supercooling performance of a material. A third Berkeley Lab study, published in Applied Physics Letters this year, describes a way to develop atomic- and molecular-scale understanding of phase-change, which is critical for the design of new phase-change materials. “Until now, most of the fundamental studies related to phase-change physics have been computational in nature, but we have developed a simple methodology to predict the energy density of phase-change materials,” Prasher said. “These studies are important steps that pave the way for using phase-change materials more widely.” Apples to apples A fourth study, just published in Energy & Environmental Science, develops a framework that will allow direct cost comparisons between batteries and thermal energy storage, which had not been possible until now. “This is a really good framework for people to compare – apples-to-apples – batteries versus thermal storage,” Kaur said. “If someone came to me and asked, ‘should I install a Powerwall (Tesla’s lithium battery system to store solar energy) or thermal energy storage,’ there was no way to compare them. This framework provides a way for people to understand the cost of storage over the years.” The framework, which was developed with researchers at the National Renewable Energy Laboratory and Oak Ridge National Laboratory, takes into account lifetime costs. For example, thermal systems have lower capital costs to install, and the lifetime of thermal systems is typically 15 to 20 years, whereas batteries typically have to be replaced after eight years. Simulation tool for deploying thermal energy storage in building HVAC systems Finally, a study with researchers from UC Davis and UC Berkeley demonstrated the techno-economic feasibility of deploying HVAC systems with thermal energy storage based on phase-change materials. First the team developed simulation models and tools needed to assess the energy cost savings, peak load reduction, and cost of such a system. The tool, which will be available to the public, will allow researchers and builders to compare system economics of HVAC systems with thermal energy storage to all-electric HVAC systems with and without electrochemical storage. “These tools offer an unprecedented opportunity to explore the economics of real-world applications of thermal energy storage-integrated HVAC,” said Berkeley Lab project lead Spencer Dutton. “Integrating thermal energy storage allows us to significantly reduce the capacity and hence cost of the heat pump, which is a significant factor in driving down lifecycle costs.” Next, the team went on to develop a “field-ready” prototype HVAC system for small commercial buildings that employed both cold and hot thermal batteries based on phase-change materials. Such a system shifts both cooling and heating loads off the electric grid. Finally, the team is deploying a residential-scale field demonstration, focusing on home electrification and shifting home heating and hot water loads. “If you think about how energy is consumed around the world, people think it’s consumed in the form of electricity, but in fact it’s mostly consumed in the form of heat,” said Noel Bakhtian, executive director of Berkeley Lab’s Energy Storage Center. “If you want to decarbonize the world, you need to decarbonize buildings and industry. That means you need to decarbonize heat. Thermal energy storage can play a significant role there.” The research was supported by Buildings Technology Office of the Department of Energy’s Office of Energy Efficiency and Renewable Energy. # # # Founded in 1931 on the belief that the biggest scientific challenges are best addressed by teams, Lawrence Berkeley National Laboratory and its scientists have been recognized with 14 Nobel Prizes. Today, Berkeley Lab researchers develop sustainable energy and environmental solutions, create useful new materials, advance the frontiers of computing, and probe the mysteries of life, matter, and the universe. Scientists from around the world rely on the Lab’s facilities for their own discovery science. Berkeley Lab is a multiprogram national laboratory, managed by the University of California for the U.S. Department of Energy’s Office of Science. DOE’s Office of Science is the single largest supporter of basic research in the physical sciences in the United States, and is working to address some of the most pressing challenges of our time. For more information, please visit energy.gov/science. – Kiran Julin contributed to this article. A phase change material is a term used for any material that both absorbs and releases heat as it changes physical state, such as from a solid to a liquid, and vice-versa. As an output for this reaction, the material will typically become either warmer or cooler depending on the phase change temperature (PCT). For this reason, PCMs provide solutions for heat/cooling storage and retention, extreme weather protection and overall energy efficiency. They’re commonly found in applications such as high-efficiency appliances, clothing, and hardware materials. Phase change materials are so useful in these applications because of a concept known as “latent” heat. This type of heat is the heat that not only changes the temperature of the material at hand but changes the physical state of that material. The most common example of a phase change material is water. In its solid form, water (or ice) requires a (relatively) huge amount of energy to melt, whereas liquid water will change the temperature using much less energy. Heating and cooling gel packs are more examples of how this concept comes to life in modern applications: the gel will liquefy as it absorbs more heat, and it will re-solidify as it sits at room temperature, solidifying completely as the environment around it absorbs the gel’s “latent” heat. Society as a whole has gravitated toward energy-efficient solutions – especially in recent years. Phase change materials have been instrumental in the progress of energy-efficient solutions of all types. From building construction to frozen food, phase change materials enable modern energy solutions. Even the fashion industry has tapped into the strategic use of phase change materials in the form of beads placed within textiles to increase the human body’s own energy efficiency. There are four main types of phase change materials: water-based, salt hydrates, paraffins, and organics. Each of these materials is used for a different energy-saving application and each comes with their own unique considerations, advantages, and disadvantages. Water-based PCMs are typically found in cooling applications, from refrigerators and freezers to gel packs. By adding an alcohol (such as glycol or ethanol) to water to prevent supercooling, the mixture’s freezing point is greatly reduced and it can therefore be an effective material in energy saving applications that reach up to -30ºC. Water is typically only useful for its phase-changing properties when used for cooling applications (to keep surrounding materials around 0ºC.). Salt Hydrate PCMs Salt hydrates are some of the most cost-efficient PCM solutions, and the most readily available. Salt hydrate PCMs also have an impressive latent heat storage capacity, which makes them suitable for thermal energy saving applications like space heaters. However, salt hydrate PCMs also come with their fair share of adversities to look out for. Of all the phase change materials, salt hydrates can be among the most toxic after paraffin. Salt hydrates also tend to be susceptible to supercooling, which may be preferable depending on the application. Finally, any application that utilizes salt hydrates should ensure that proper measures are taken to account for volume changes as the material changes phases – the volume of salt hydrates may change up to 10% during a phase transition. Paraffin PCMs Paraffin PCMs are other favorable material options depending on the application. Paraffins offer stability in their formulation over other competing organic compounds, which makes them more durable during heating and cooling processes. They are also non-corrosive, which is a huge asset when paired with metal materials that are exposed to moisture. However, paraffin comes with several disadvantages, too. Derived from petrol, paraffin PCMs are typically hazardous to people. Similarly, their fossil fuel roots make paraffin a relatively unsustainable option. Cost-savings are also at risk when using paraffin, as their prices are closely tied to the volatile oil and gas industry. Plant-based PCMs Some of the most preferable phase change materials are plant-based. These organic compounds are free of toxicity, typically have high latent heat capacity, and are cheaper than most paraffin PCMs. Plant-based PCMs (and some made of animal fat) are found to be more efficient than salt hydrates and paraffin, and typically have a wide range of melting points depending on the raw materials involved. Some manufacturers might find it difficult to rely solely on plant-based PCMs, however, due to their higher-than-average price point compared to the preceding options. No two phase change materials are alike, and each application warrants its own unique solution. When deciding on the type of PCM for your project, ensure you’ve taken the following measures into consideration: Latent heat (J/g) Temperatures involved Corrosiveness Lifecycle Price For direct consult on the right PCM solution for your next project, reach out to our team at KRA Fabrication today.

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