Cutting-edge research is taking lead batteries to the next level

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Here, the Consortium for Battery Innovation argues that cutting-edge research is taking lead batteries to the next level

Energy storage is critical to our collective future. At the Consortium for Battery Innovation (CBI), we are committed to ensuring this technology continues to advance by initiating collaborative research projects and setting targets for the whole lead-battery industry. We have developed a detailed technical roadmap to establish targets and drive innovation across several critical global markets–notably automotive, stationary energy storage, motive power, and industrial applications. In this article, we take a foray into some cutting-edge work the CBI and its community are undertaking.

Vehicle electrification driving the next generation of lead batteries

Do you think the lead battery will disappear with the shift to electric vehicles? Think again. Electrification is a pervasive trend in the automotive sector. While internal combustion engine vehicles dominate, electrification in the shape of start-stop and micro-hybrid vehicles already represents a large share of this market. According to leading energy-storage-market analysts Avicenne Energy, around 60% of new vehicles globally will be micro-hybrid in 2030, including close to 80% in Europe and 75% in the United States. The performance of lead batteries has already increased significantly in the last ten years, resulting in widespread use in start-stop and micro-hybrid applications. Post-2030, a transition to fully electric vehicles will greatly impact battery technologies. Electric vehicles utilise at least two batteries: A propulsion or traction battery and a low-voltage safety battery. Currently, most electric vehicles are equipped with a high-voltage lithium-ion battery to provide propulsion.

In addition, virtually all EVs use a lead battery as the 12 V safety battery. The latter battery powers critical vehicle functions and is vital in emergency situations. For instance, if the traction battery fails, the low-voltage lead battery powers essential safety features, such as steering and braking so the vehicle can pull over safely. Automotive remains a hugely important market for lead batteries, and future enhancement is necessary. In particular, CBI programs are looking to improve charge acceptance whilst increasing cycle life and lifetime, both key technical parameters in this application space.

Energy storage systems need improved batteries

Battery energy storage systems (ESS) are a critical technology. ESS is vital to meeting the ambitious goals and targets set by governments around the world. Forecasters agree that the demand for ESS will be significant and require battery technologies to meet future electrification and decarbonisation targets. Lithium-ion batteries will be a key ESS

player but meeting future market needs will require more than one technology. Lead batteries are the only other technology that can meet these requirements on a mass-market scale. Innovation is vital in the ESS area. If lead batteries can increase their cycle life and calendar life, it will lower the total cost of ownership for the ESS system. This would, in turn, make the whole system more cost-effective and increase the uptake of battery energy storage. This is a key goal for CBI in 2023. Indeed, we have set specific targets for ESS applications: Increase cycle life, increase calendar life, and lower TCO. We expect that energy storage will, therefore, represent a significant market for lead batteries in the future

Empowering off-grid communities

CBI is an example of an organisation undertaking cutting-edge government-funded research. Battery energy storage systems have huge potential, combined with renewables, to enable reliable, sustainable electricity supplies to groups of the global population who cannot connect to grid infrastructure. CBI and nine project partners recently won coveted Horizon Europe funding to develop and deploy a modular off-grid energy solution for a community that currently has no access to a reliable source of energy. The project will develop next-generation lead batteries for electrical energy storage. We will debut a low-cost lead-battery-component-based electrolyser for creating hydrogen for clean cooking applications.

Carbon additives for better batteries

Our global research programme also includes fundamental R&D that has the power to cut across multiple applications. Lead batteries are widely used in the aforementioned automotive and energy-storage applications because they are cost-efficient, inherently safe, and offer high recyclability. In such applications, lead batteries are usually operated at a partial state of charge operations, which might result in a failure of the batteries due to the irreversible accumulation of lead sulfates. The addition of small amounts of carbon additives (e.g. carbon black, activated carbon, graphite and graphene) in the negative plates is known to enhance the charge acceptance and cycle life of lead batteries, critical technical requirements for both energy storage and automotive applications. These carbon additives improve battery performance by increasing the electrochemical active surface area and enhancing the charge transfer reaction.

Critical advances of lead batteries

From powering generations of vehicles to enabling the rollout of renewable energy and providing uninterrupted power to critical services such as telecommunications, lead batteries are already a hidden hero. But lead-battery innovation is vital–we need it not only to underpin energy provision, future mobility, and connectivity but also to enable GHG reduction, energy security, and the shift to a more circular economy.