FRANCE 2030 PROGRAMME DE RECHERCHE BATTERIES

PEPR Batteries

BATTERIES TOMORROW

EDITORIAL

Dear readers,

The annual seminar of the PEPR Batteries, held on January 14th and 15th at the MINATEC House in Grenoble, was a highlight for our community. This event provided an opportunity to review the mid-term progress achieved by the projects. This issue showcases the concrete results shared during the seminar, illustrating the richness and complementarity of our research axes.

We warmly thank all the teams for their commitment and our institutional partners for their trust. Together, we continue our mission: to place research and innovation at the service of the ecological transition and the energy challenges of tomorrow. Happy reading,

Hélène Burlet and Patrice Simon

PROJECT MID-TERM ADVANCES

Discover the highlights of the 4th edition of the "PEPR Batteries Days": a rich program featuring research results, scientific advancements, and future perspectives.

Read more...

Understanding Electrolyte Degradation in Aqueous Redox Flow Batteries

The RADICAL project aims to design a new, stable electrolyte for aqueous redox flow batteries operating at neutral pH, while adhering to a sustainable development approach. These batteries must overcome performance challenges—particularly in terms of electrolyte stability—to become a competitive industrial alternative to other technologies. A detailed understanding of the degradation mechanisms of redox-active species remains a major scientific hurdle in the development of aqueous RFBs, especially for organic nitroxide radicals, which are currently among the most promising candidates for next-generation posolytes.

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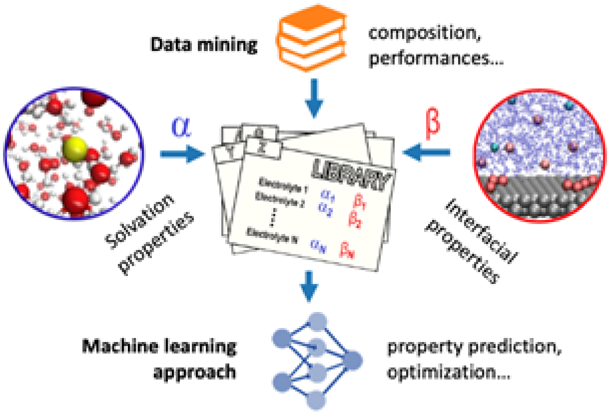

An in-depth understanding of electrolytes for divalent cation batteries, enabling rational design and the development of predictive tools

The LEGEND project aims to design electrolytes for divalent cation-based batteries, specifically using Ca(II), Mg(II), and Zn(II)—abundant elements that offer high energy density. The rational design of high-performance electrolytes requires a deeper understanding of ion solvation and transport mechanisms, as well as structuring and deposition phenomena at electrode interfaces. This project leverages and develops molecular simulation methods and machine learning to build a library of high-potential electrolytes, which will be experimentally validated.

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HIPOBAT is approaching its mid-term: fundamental research on high-power batteries, demonstrations for industrial applications, and Franco-German collaboration

The HIPOBAT project aims to develop high-power batteries capable of rapid charging and discharging while maintaining adequate energy density. As the first bilateral battery research cooperation project in Europe, it seeks to establish strong ties and seamless knowledge exchange with the seven German laboratories involved in the consortium.

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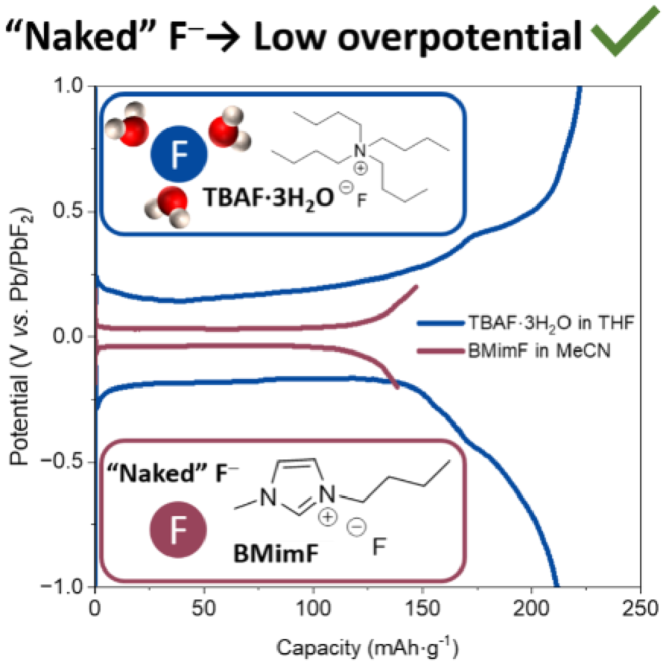

New Electrolyte for Fluoride-Ion Batteries

The FRISBI project aims to develop all-solid-state fluoride-ion batteries as an alternative to lithium-ion batteries, due to their high theoretical energy densities. The work focuses on designing solid electrolytes with high ionic conductivity, exploring fluorinated electrode materials, and integrating these components into electrochemical cells. Tin-based electrolytes showing promising ionic conduction are being studied, and various structural families of electrode materials are being explored.

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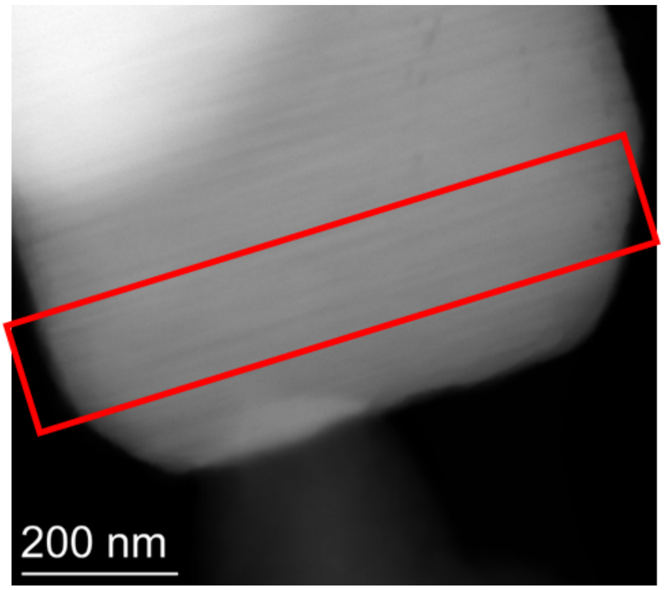

Syntheses and Modifications of Electrode Materials

The HIPOHYBAT project aims to develop sustainable, safe, low-cost batteries that combine both high power and energy density. Relying solely on conventional synthesis methods for electrode materials would inevitably be limiting, so from its inception, the project considered more innovative—yet riskier—strategies to achieve its goals. After three years, these research avenues have borne fruit, and far from competing, synergies are beginning to emerge with compelling results. The battle between the Classics and the Moderns will not take place!

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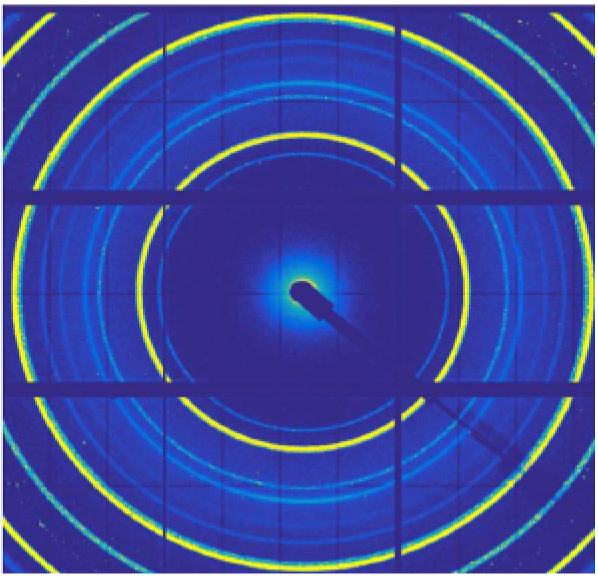

Structuring a French operando characterization platform for next-generation batteries

The OPENSTORM project (OPerando Energy STORage Materials analysis) aims to establish a French advanced characterization platform for batteries under operating conditions, spanning from laboratory-scale to large-scale facilities (synchrotron and neutron sources). Its goal is to accelerate the understanding of the structural, chemical, morphological, and interfacial mechanisms that govern the performance and durability of next-generation batteries (all-solid-state, high-power, and post-Li-ion systems).

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Development of bioresorbable Na-ion batteries for temporary medical applications.

The SIMBA project aims to develop flexible bioresorbable batteries for temporary medical applications.

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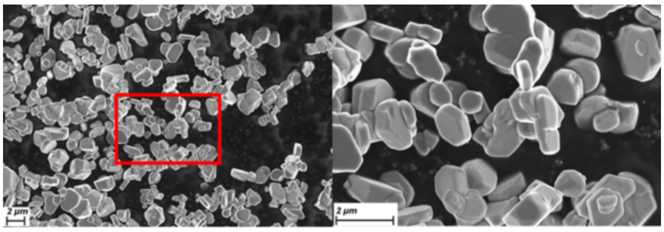

Latest advances in all-solid-state lithium metal batteries.

The LIMASSE project aims to develop and optimize materials, coatings, and processes to prepare all-solid-state cells using NMC/Li metal and Sulfur/Li metal chemistries, leveraging advanced characterization techniques. The latest advances of the LIMASSE project, with a focus on the development of materials and coatings, were presented at the PEPR Batteries Days on January 14 and 15, 2026.

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Organic anion-ion batteries: ambitions and first milestones of the SONIC project

The SONIC project aims to develop “anion-ion” batteries using organic electrode materials and a solid polymer electrolyte, completely free of critical elements such as lithium, cobalt, or nickel. The approach relies exclusively on p-type organic redox compounds with anionic charge compensation and cationic polymer electrolytes that conduct only anions (BF_4^-), with the ultimate goal of integrating them into a pouch cell.

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High-energy-density aqueous organic redox-flow batteries: specifically designed mediators and boosters.

The DISCOVERY project aims to increase the energy density of aqueous organic redox flow batteries (AORFBs), a promising technology for storing intermittent energy. To achieve this, insoluble redox species (boosters) are added to the reservoirs that can exchange electrons with soluble redox mediators in the aqueous electrolyte. For the battery to function properly, the redox potentials of the boosters and mediators must be similar, and the electron exchange reaction must be rapid and spontaneous.

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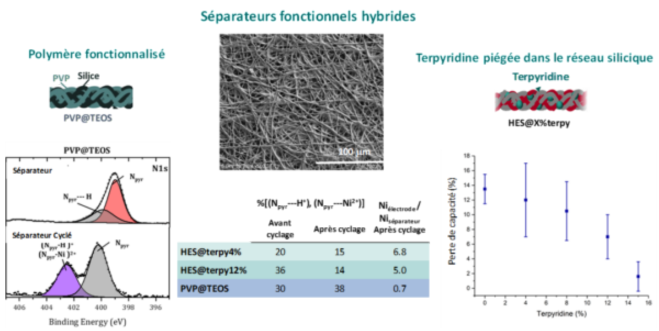

Innovative separators capable of trapping metals to slow down the aging of lithium-ion batteries.

The HEAL B and B project is developing a new generation of functional separators for lithium-ion batteries, transforming this component — traditionally chemically passive — into an active element for improving cell stability and longevity. The objective is to limit electrochemical aging processes, in particular the degradation of the Solid Electrolyte Interphase (SEI) — a protective layer at the negative electrode’s surface. This degradation is often caused by the migration and electro-reduction of transition metals (such as nickel and manganese) dissolved from the cathode, which accelerate SEI breakdown and the performance loss of batteries.

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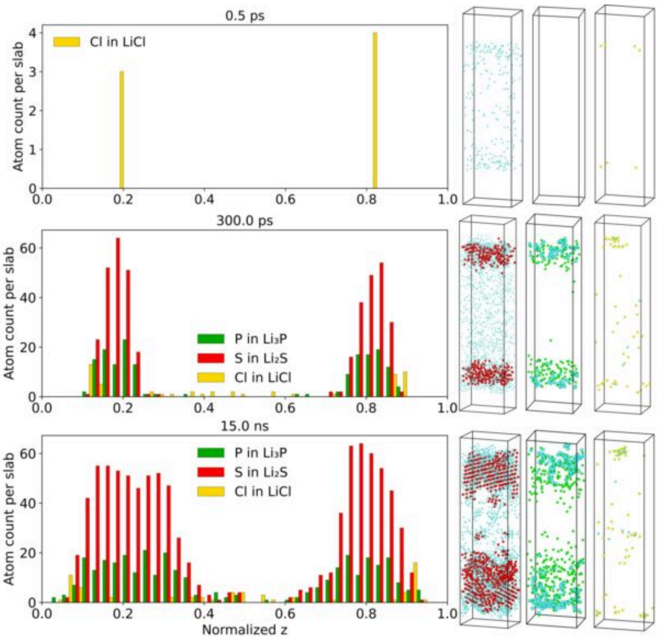

Artificial intelligence makes it possible to model the batteries of the future, from the atomic scale to the manufacturing process.

The BATMAN project aims to achieve several major advances in understanding and optimizing electrodes for next-generation batteries by combining advanced modeling with innovative machine-learning approaches. These efforts help accelerate the development of energy storage systems that are more efficient, more durable, and better suited to the growing needs of electrification.

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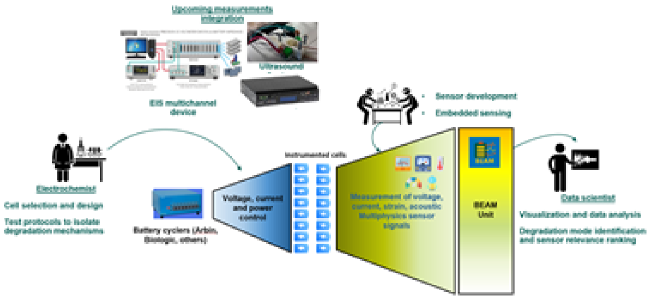

Smart operando sensing for advanced BMS / AI data mining

The SENSIGA project, launched in January 2023 and planned for six years, aims to transform cell battery monitoring by combining optical sensors integrated into the cell, embedded multiphysics sensors, and artificial intelligence algorithms. It is coordinated by the CEA (V. Heiries) and the Collège de France (C. Gervillié-Mouravieff) and brings together six partner laboratories (CEA Leti, CEA Liten, Collège de France, LAMBE, PHENIX, ISCR).

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