

Young Scientist Battery Manifesto Topic1: New Technologies

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Battery technologies are central to the energy transition and Europe's climate and industrial goals. This contribution outlines key trends in next-generation batteries and how targeted research and innovation can accelerate their development. We call for more open, application-driven research, where results, including negative or inconclusive data, are shared to foster collective learning and reduce redundancy. Technological priorities include integrating smart functionalities such as real-time sensing and self-healing materials to improve safety, lifespan, and leveraging AI in battery management systems for predictive diagnostics and adaptive charging. Decentralized storage systems, especially in urban settings, and hybrid solutions like battery-supercapacitor or battery-fuel cell combinations offer increased flexibility and resilience. A structured innovation roadmap is proposed. In the short term, the focus is on enhancing lithium-ion systems and scaling sodium-ion technologies, both offering gains in performance, cost, and sustainability. Medium-term priorities include solid-state and redox-flow batteries, with expected improvements in safety and scalability. Long-term research targets transformative systems like lithium-sulphur, multivalent, and metal-air batteries. The roadmap aligns with European supply chains, sustainability goals, and industrial integration to create a resilient, competitive battery ecosystem. Collaborative innovation and transparent research practices are essential to building the next generation of sustainable, high-performance energy storage technologies.