Transforming new concepts into real-world batteries: A complex journey

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Proposing new concepts, identifying new materials, and unravelling novel mechanisms, are part of the scientific journey towards the development of successful battery technologies. Numerous advances, despite initially being scientifically tantalizing, rapidly fall into oblivion or take too long to materialize. Quite frequently, the excitement generated by achieving an outstanding performance at the electrode level cannot be turned into practical batteries that must excel in several figures for being market-competitive.

With this in mind, the outcome of Li-rich NMC materials having exacerbated capacities, together with the development of sustainable Na-ion batteries, will be discussed. Firstly, the underlying science that triggers a reversible anionic-redox process, as deduced from model compounds, will be briefly recalled so as to highlight the key practical bottlenecks of this mechanism, such as its voltage fade and its sluggish kinetics that is accompanied by poor energy efficiency and heating issues. Although we hope for solving such limitations, they presently jeopardize the early anticipated supremacy of Li-rich NMC against nickel-rich NMCs which are constantly improving, and the long-term outcome between both, therefore, remains hanging in the balance. Turning to Na-ion batteries, although not as awe-inspiring in terms of fundamental science, we will show how by manipulating the materials' composition and by confectioning a new electrolyte formulation via tedious iterations, we could master the Na-ion system for extensive prototyping.

Together, these examples will illustrate the benefits/excitement of carrying out fundamental research on concrete technological problems to maintain practical reality, while broadening our applied scope since some of our synthesized model materials turn out to be attractive for other energy-related applications.