New materials for secondary Na-ion batteries targeting at sustainability and high performances

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Nowadays, the wordwidely ongoing energy transition has pointed out the pressing need for new energy storage technologies based on abundant and low-cost materials, to satisfy the exponentially increasing market demand and to overcome the current scarcity of some key and critical elements, such as lithium and transition metals (Co and Ni, primarily).

In this respect, secondary sodium-based batteries display great advantages in terms of high-energy density, low-cost, and simple manifacturing. In this work, different cathode and anode materials were explored in lab-scale Na-metal cells. These materials include high entropy oxides (HEO) and Prussian Blue analogues (PBAs) as cathodes, and carbon-based materials as anodes. On one side, HEO are innovative materials where multiple cations within the same crystal phase contribute to the overall behavior, while PBAs have attracted wide attention due to low cost, easy and tunable synthesis, and high versatility [1]. On the other side, carbonaceous materials can be obtained from the pyrolysis of waste materials, such as biomasses or disposed face masks, which are so repurposed into high-value applications [2].

All of these electrode materials were tested in combination with standard electrolytes (based on organic solvents), but also with electrolytes based on room-temperature ionic liquids (RILs), with great advantages in terms of safety, low toxicity and flammability [3]. Lab-scale Na-metal and Na-ion cells were fully characterized by means of electrochemical impedance spectroscopy, cyclic voltammetry and galvanostatic charge/discharge cycling. Materials exhibited relatively high specific capacities with high coulombic efficiency (above 98% even after prolonged cycling, up to 1000 cycles).

Furthermore, many efforts are also dedicated in the frame of SUNRISE European project to the recycle of polyvinyl butyral (PVB), which is used as polymeric interlayer into laminated glass for construction and automotive. Up to now, most of the post-consume PVB from laminated glass is incinerated or landfilled, causing the loss of 125000 tons per year. Our goal is to apply in energy storage systems the fraction of recycled PVB that does not fulfill the optical and mechanical requirements for being reused into the original glass manufacturing process. Particularly, the recycled PVB can be used as a binder in the electrode preparation and/or as a separator. In order to be competitive with conventional binders and separators (such as CMC and PP/PE, respectively), the costs of the whole recycling process have been targeted at 10 $/kg for the binder and 60 $/kg for the separator [4].

In conclusion, the independent optimization of each component of the energy storage systems will thus contribute to improve the whole value chain and foster the broadly coveted energy transition.

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