Seasonal Energy Storage: The new challenge for electrochemistry

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The European Strategic Energy Technology Plan established the transformation to climate neutrality by 2050 since energy production is responsible for 75% of the greenhouse gas emission in the EU.[1] For this transformation, the use of renewable energy sources and clean energy carriers should be drastically increased.

In this scenario, long-term (seasonal/annual) energy storage is the key towards a low-carbon energy system. Lithium-ion batteries (LIBs) have addressed the market for portable electronics and electric vehicles. However, energy storage devices that meet the cost, raw material availability and good performance requirements for seasonal/annual storage do not exist yet. Reactive metals, i.e., metals that spontaneously oxidize in contact with air and/or water, appear to be promising for seasonal/annual storage systems, granting higher volumetric energy density and easier storage than hydrogen.

Among the various reactive metals, Na, Mg, Zn, Fe, Al, to cite a few, Na-seawater batteries, making use of multiple electrolytes, i.e., seawater as the catholyte (as well as the cathode material), a solid electrolyte physically separating the two electrode compartments, and a non-aqueous anolyte, have been already demonstrated feasible.[1] Because natural seawater is also the active material in the open-structured cathode, the Na seawater battery can be supplied infinitely with Na^+ cations, which are transferred to the anode side during charging. The generated sodium can be stored inside (for daily/weekly storage) and/or outside (for seasonal/annual storage) the cell. The process can be reversed during discharge, delivering electricity on demand. As additional benefits, Na-seawater batteries upon charge produce desalinized water (for industrial and residential uses), and chlorine (for bleach, disinfectant, and polymer chemistries) while during discharge generates NaOH, which can be used for CO_2 capture.

References

1 Y. Kim *et al*, Sodium Biphenyl as Anolyte for Sodium–Seawater Batteries, Adv. Funct. Mater. 2001249 (2020)