Photoelectrochemical cells: from water splitting to electrochemical energy storage

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Electricity produced from solar and wind energy sources have limited or no dispatchability, making storage of energy a hot research topic. Pumped-storage hydroelectricity has several advantages, namely high capacity, reasonable response time, high cycle efficiency and low costs. However, for countries of limited hydraulic energy resources and for local storage, other approaches should be considered.

Redox flow batteries (RFB) store energy in electrolyte solutions upon anodic and cathodic reversible redox reactions, as sketched in Figure 1. Storage capacity and power are independent variables in RFB, which are suitable for stationary applications due to the low storage costs, high cycle efficiency and low energy storage density.

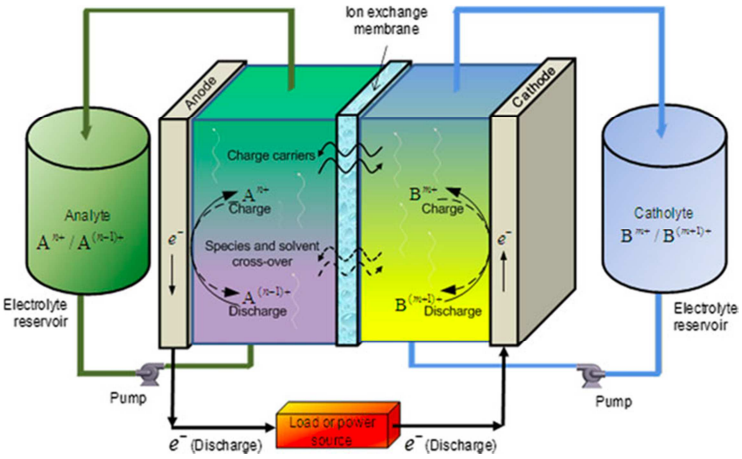

Figure 1 – Sketch of a redox flow battery (extracted from [1]).

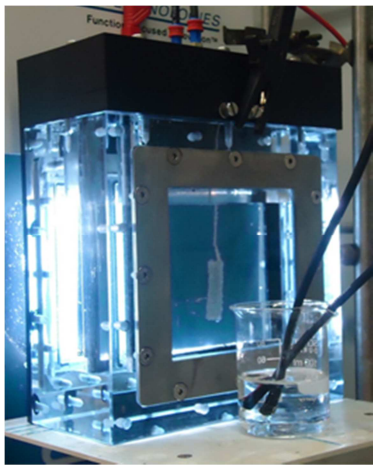

Figure 2 – Photoelectrochemical cell "PortoCell"

The implementation of directive (2010/31/EU) concerning "nearly zero-energy buildings" will require the storage of energy in buildings. Though, RFB can be used with advantages for this objective, it would be great if they can be directly charged from solar radiation besides other energy sources such as urban wind power or BIPV. Very recent results by the authors show that not only this is possible but thermodynamic energy conversion efficiencies up to 40 % are possible. This work deals about this new development that requires the use of photoelectrochemical cells – Figure 2.

References

[1] – Weber, A., Mench, M., Meyers, J., Ross, P., Gostick, J., Liu, Q., "Redox flow batteries: a review", J. Appl. Electrochem., DOI 10.1007/s10800-011-0348-2, 2011.