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Keynote Lecture by

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Electricity from renewable sunlight: cheaper and cleaner

In the 16th century Thomas More described an ideal and sustainable city in his book Utopia. Today´s ideal city should comply with the Near Zero Energy Building directive and going beyond.

Photovoltaic (PV) electricity is already today the cheapest, if produced in countries with high solar irradiance. However, PV electricity is only generated during the daylight time and then just partially dispatchable. To make it fully dispatchable it is necessary to store it and batteries storage is a technology of choice. Among electricity storage technologies, redox flow batteries (RFB) emerged as promising offering low storage costs – expected of 3 ¢€/kWh/cycle [1], independent power from storage capacity, very reliable and robust operation. The all vanadium RFBs display an energy density that can reach 50 Wh/L but the use of non-aqueous solvents for dissolving the redox pairs promise to bring soon this energy density to values that ideally can reach 1 kWh/L. The storage of electricity is made in an electrochemical fluid – electrochemical fuel, instead of being made in a solid such as in conventional batteries, which opens the doors for easy storage and transport.

More recently, it was proposed the direct conversion of sunlight into storable electrochemical fuels using photoelectrochemical panels. These panels comprehend just a glass window coated with a semiconductor and an ion-exchange membrane; the positive and negative electrolytes pass through charging and heating up in a cogeneration process. The solar redox flow batteries promise to bring the cost of stored electricity to even lower values making the dream of self-energy sustainable cities a closer reality.

References

[1] https://ens.dk/en/results-search?t=Status%20and%20recommendations%20for%20RD%26D %20on%20energy%20storage%20technologies%20in%20a%20Dan – consulted in March 2017.

About the author

Professor Adélio Mendes (born 1964) received his PhD degree from the University of Porto in 1993. Full Professor at the Department of Chemical Engineering of the Faculty of Engineering of the University of Porto. Professor Mendes coordinates a large research team with research interests in dye sensitized solar cells and perovskite solar cells, photoelectrochemical cells, photocatalysis, redox flow batteries, electrochemical membrane reactors (PEMFC, H-SOFC, chemical synthesis), methanol steam reforming, membrane and adsorbent-based gas separations and carbon molecular sieve membranes synthesis and characterization.

Professor Mendes co-authored 290 articles in peer-review international journals, filled 22 families of patents, and was the author of a textbook. In 2012, he received an Advanced Research Grant from the ERC on dye-sensitized solar cells for building integrated of ca. 2 MEuros. He received several prizes, namely Air Products Faculty Excellence 2011 Award (USA), Solvay & Hovione Innovation Challenge 2011, ACP Diogo Vasconcelos Applied Research Award 2011, City of Porto Merit Municipal Medal in 2015 and Coimbra University in 2016. Presently, he is the Coordinator of CEner-FEUP, the Competence Center for Energy of the Faculty of Engineering at the University of Porto.