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Recent Highlights on Solid Oxide Electrolysis (SOE) Technology at Cells, Stacks and Modules Scale

Julie Mougin^a, Jérôme Laurencin^a, Julien Vulliet^b, Marie Petitjean^a, Elisa Grindler^a, Stéphane di Iorio^a, Karine Couturier^a, Karl Vulliez^a, Géraud Cubizolles^a, Félix Bosio^a, Jérôme Aicart^a

^aUniv. Grenoble Alpes, CEA/LITEN, 17 rue des Martyrs, 38054 Grenoble Cedex 9/France ; ^bCEA/-Le Ripault, DMAT, F-37260 Monts, France

Presenter Contact Details (Email): julie.mougin@cea.fr

Abstract

Hydrogen can play a key role, as a resource for industrial processes, a fuel for transportation, and a vector for high-capacity and/or long-distance electricity storage [1]. A sharp increase in the share of hydrogen in the overall European energy mix is expected, with a value reaching 13-14% in 2050 against less than 2% currently [2]. In this context, it will be necessary to increase the production capacity of carbon-free hydrogen, primarily through water electrolysis. At European level, a deployment plan for 100 GW of electrolysis is thus proposed by 2030, allowing during its operation to produce 10 million tons of hydrogen per year, to which are added an additional 100 GW for export [1]. However, the production of carbon-free hydrogen is currently not competitive with conventional production routes from fossil fuels (methane steam reforming in particular). The deployment of high-power electrolyzers is likely to significantly lower the cost of the hydrogen produced.

But the efficiency of the electrolyzers is also a key parameter towards the Levelized Cost of Hydrogen (LCOH). From that perspective, Solid Oxide Electrolysis (SOE) presents the highest efficiency and is therefore considered to be an highly promising technology to produce hydrogen at low cost [3-4]. In addition, it still has a significant potential for innovation, making it possible to gain in performance and lifetime. To reach large electrolysis plants, the upscaling of the different components of the SOE technology is a cornerstone, which includes cells, stacks and modules. The status of development of the technology will be presented, as well as the remaining challenges. The current R&D developments performed to meet those challenges will be detailed.

- [1] European Commission, *REPowerEU: affordable, secure and sustainable energy for Europe*, **18 May 2022**
- [2] European Commission, *A hydrogen strategy for a climate-neutral Europe*, **8 July 2020**
- [3] J. Mougin *Compendium of Hydrogen Energy*, Volume 1: Hydrogen production and purification, edited by V. Subramani, A. Basile and T.N. Veziroglu, Woodhead publishing series in Energy, Elsevier, **2015**, pp.225-253
- [4] Clean Hydrogen Joint Undertaking, *Strategic Research and Innovation Agenda 2021 – 2027*, <https://www.clean-hydrogen.europa.eu>, **February 2022**