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Abstract

The electrolysis capacity has to been significantly expanded under the Net Zero Emission scenario[1] to above 700 GW by 2030. However, the global electrolysis capacity currently is at a low level of 1–2 GW. This needs the acceleration of the developments for competitive electrolysis technologies. Solid oxide electrolyser cells (SOE or SOEC) is one of the main potential electrolysis technology which is still under maturing (TRL5-7)[2,3]. The primary challenge facing SOE technology is its limited stack lifetime, which typically only lasts around 20,000 hours in laboratory conditions[2]. This is still shorter than the stack lifetimes of Alkaline electrolyzer (60,000–90,000 h[3]) and Proton exchange membrane electrolyzer (PEM, 40,000–80,000 h, information provided by suppliers). In addition, the scale-up for SOE electrolyzer is another obstacle to the large-scale implementation and commercialization of this technology. Currently, the cell (active area) and single stack size are at the levels of 100 cm2 and 12.5 kW[2], respectively, which are much lower than those of the commercialized alkaline electrolyzer (scale in MW) and PEM electrolyzer (scales in hundreds of kW).

This work investigated the dynamic operation method for SOE named "AC:DC", which has been proposed in recent times and proved to effectively address the two challenges mentioned above[4,5]. The results of both experimental and modeling studies on SOE cell under AC:DC operations are presented. The potentials of AC:DC in improving lifetime and temperature variations for SOE cell are discussed.

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