Hydrogen Production via Solid Electrolytic Routes

Dr Christopher Munnings*, Dr Sukhvinder Badwal and Dr. Sarbjit Giddey
CSIRO Energy technology
Private Bag 33, Clayton south MDC, Vic.3169, Australia
c christopher.munnings@csiro.au

Hydrogen is one of the most widely used industrial chemicals. It is key feedstock for the production of agricultural fertilizers and many specialty chemicals. Most of the hydrogen currently is generated from fossil fuels. Concerns relating to air quality and emissions driven global warming have lead to pure hydrogen being increasingly considered as a potential transport fuel. This then would lead to exponential increase in demand for hydrogen. Conversely, increasing environmental concerns and fluctuations in the price and availability of hydrocarbon fuels is making traditional industrial hydrogen production routes less attractive. These factors and the increased penetration of intermittent renewable energy sources into national grids make electrolytic hydrogen production an obvious potential solution to many of the conflicting problems faced by the global energy sector. In addition to large scale energy market driven demand, micro-fuel cells used for battery charging are becoming increasingly popular with sales of these devices increasing from a few thousand to over two hundred thousand in the past 5 years. Due to the lack of hydrogen retail infrastructure these devices are generally operated on either purchased methanol or hydrogen generated in domestic electrolysers. These two very different applications are providing a number of challenges and opportunities for devices that produce hydrogen via solid electrolytic routes.

Devices that rely on solid electrolytic cells for the production of hydrogen are particularly attractive due to their robustness, scalability, low toxicity, high efficiency and simplicity. Devices can be scaled from small domestic units producing a few ml of hydrogen per minute to large scale devices which, in addition to generating large amount of hydrogen, could also potentially harness waste heat from industrial processes, nuclear power stations or solar concentrators with reduction in the electrical energy input. This paper reviews the current state of the art in this field with a particular emphasis on direct coupling of electrolysers to intermittent renewable sources and high temperature electrolysis which can be coupled with thermal solar concentrators.