Galates with perovskite-related structure as membrane reactors for hydrogen production from water splitting

M. Al Daroukh, G. Georgi, M. Hoffmann

Leibniz Institute for Catalysis, Rostock, Germany

Abstract

Hydrogen production from water splitting will be the most promising energy source in the future [1-2]. Dense membranes of the type $La_aSr_bGa_cMg_dO_x$ were prepared from powders by solid state reaction syntheses. The Galates show a very high ionic conductivity [3]. The water splitting is achieved thermically, while the Diffusion of oxygen through the dense galate membrane is realized thermically and electrically. The electrically achieved oxygen permeability is three times higher than the thermically achieved. Due to this fact, the hydrogen production increases by the same factor. In a special reactor (Fig. 1) the dense tablet of the polyoxid is fastened between two gold rings. The tablet is coated with a platinum layer on both sides which work as electrodes. Helium with water is flowing towards the negative pole while on the other side after tablet (positive pole) an Ar or Ar/H_2 flow is realized. The reactor in the furnace is heated to 1050 °C and slowly cooled to the chosen reaction temperature (e.g. 800°C). In both sides of the dense tablet an electric current of 2 A is used. Two ampere corresponds to 8 volts at these high temperatures. The whole investigation was measured by a solid electrolyte device (Fig. 2) (ZIROX SGM5EL) [4]. The oxygen concentration was measured before and after the permeation. At 800 °C the oxygen permeation has a value of 0.6 $ml/(cm^{-2}.min.)$ (Fig. 3-4).

References

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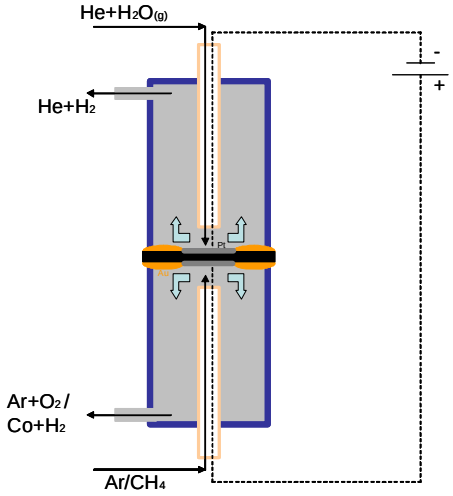
[2] U. Balachandran, T.H. Lee, S. Wang, S.E. Dorris**,** Use of mixed conducting membranes to produce hydrogen by water dissociation, J. of Hydrogen Energy 29 (2004) 291–296.
[3] N. Trofimenko**,** H. Ullmann, Co-doped LSGM: composion-structure-conductivity relations, solid state ionics 124 (1999) 263-270.
[4] K. Teske, H. Ullmann, N. Trofimenko**,** Thermal analysis of transitions metal and rare earth oxide system-gas interactions by a solid electrolyte-based coulometric technique, J. Thermal anal. 49 (1997) 1211–1220.

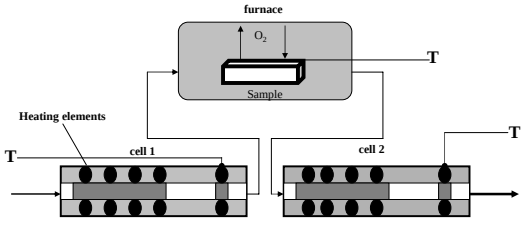
Figures

Figure 1



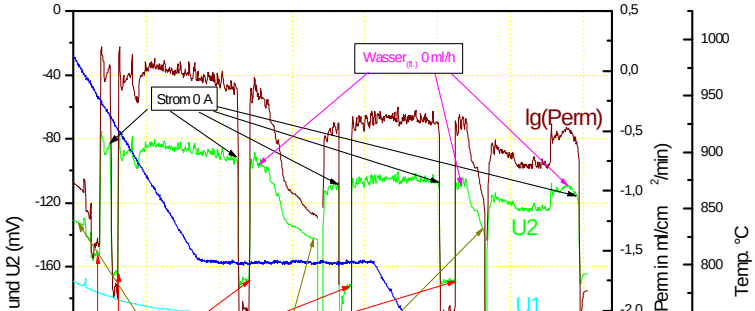
Reactor for the oxygen permeability and hydrogen production

Figure 2



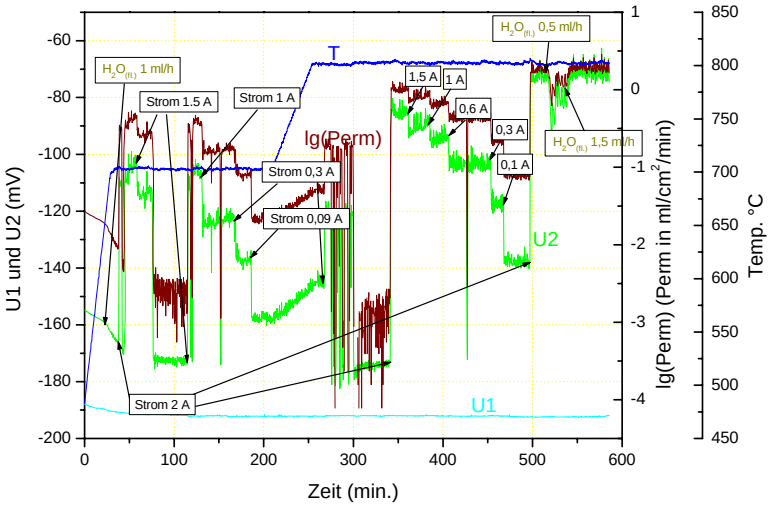
Solid electrolyte device

Figure 3



The effect of current application to oxygen permeation and hydrogen production

Figure 4



Dependence between oxygen permeation and change the electrical current