

channels. In this study, we report effects of materials on performances of the cathode-supported SOFC using a small-scale cell based on micro-tubular LSM support at the intermediate temperature operation. The cathode-supported micro-tubular cell with 1.6mm diameter has been successfully fabricated using the same techniques as honeycomb SOFC. And its electrochemical properties were evaluated in a temperature range from 500°C to 800°C. Our prepared micro-tubular cell with electrode length of 10mm showed the power density above 0.13W/cm<sup>2</sup> and 0.30W/cm<sup>2</sup> at 700°C and 800°C, respectively, in H<sub>2</sub> fuel flow.

Keywords: honeycomb support, electrode support, cell accumulating ability, scandia stabilized zirconia

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#### [P80]

##### Water transport through a PEM fuel cell: A one-dimensional model with heat transfer effects

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One of the critical problems and design issues of PEM fuel cells is the water management because the membrane's hydration determines the performance and durability of the cell. In this work, a steady state, one-dimensional model accounting for coupled heat and mass transfer in a single PEM fuel cell is presented. Two-phase flow effects are neglected. The anode and cathode flow channels are treated using the continuous stirred tank reactor (CSTR) approach. The cell voltage expression incorporates the anodic and cathodic overpotentials as well as the ohmic losses across the membrane. The reactions in the catalyst layers are considered as homogeneous. The kinetics of the cathodic oxygen reduction is modelled using the Tafel equation while a modified Tafel expression is used to describe the anode losses. Pressure gradients across the layers are assumed as negligible. Mass transport in the diffusion layers and membrane is described using effective Fick models. Local equilibrium at interfaces is represented by partition functions. Water transport through the membrane is assumed to be a combined effect of diffusion and electro-osmotic drag. It is assumed that the membrane proton conductivity and water diffusivity are a function of  $\lambda$ , the number of water molecules per ionic group. The heat transport through the gas diffusion layers is assumed as a conduction-dominated process. The thermal conductivity for all the materials is assumed as constant. Heat generation or consumption is considered in the catalyst layers. The analytical solutions for concentration and temperature across the cell are computed.

Particular attention is paid to the water distribution across the membrane. The influence of different parameters (such as the current density and the level of humidification of inlet gases) over the water transport and on the cell performance is studied. The model is validated with recent published data and with experimental results obtained with an in-house designed PEMFC (25cm<sup>2</sup> of active area). This easily implemented simplified model is suitable to define the optimal hydration conditions of the membrane.

Keywords: Proton exchange membrane fuel cell (PEMFC), modelling, heat and mass transfer, thermal effect

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#### [P81]

##### Investigation of transport phenomena in a 7-serpentine channel PEM fuel cell

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The paper presents a study on the transport phenomena related to fluid flow in a 7-serpentine channel PEM fuel cell. 3D multi-physics modelling using Fluent - Fuel Cell Module is used for geometry design and fluid flow analyses in order to predict fuel cell performance.

Transport phenomena occurring in fuel cells are characterized by a large range of length scales (from micro scale to macro scale) and time scales. In this paper we discuss oxygen/proton