YTTRIA-STABILIZED ZIRCONIA MICROTUBES AS SOLID OXIDE FUEL CELL ELECTROLYTE

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Yttria-stabilized zirconia (YSZ) is widely used as an electrolyte in high temperature solid oxide fuel cells (SOFC), placed between an anode and a cathode of the element. To increase the power density of the cells, shorten the start-up times and increase the mechanical durability many research groups have been focusing on miniaturizing SOFCs. Tubular cells in particular can, be constructed in a way that their gas joints and electrical contacts can be left outside of the hot zone. The main obstacle of the miniaturization is the lack of methods for preparing thin-walled metal oxide tubes in microscale. First microtubular SOFCs, constructed in 1991 by K. Kendall using YSZ electrolyte tubes (diameter 1 to 5 mm; wall thickness 100–200 µm) as support structures, were described as mechanically highly stable, but with low electrical efficiency [1]. Since then, the focus has been shifted to the extrusion of highly porous, min. 1 mm diameter, anode and cathode tubes used as supporting structures for electrolyte layer. No method has been proposed to prepare electrolytes in the form of self-standing, thin-walled (max. ~20 µm) microtubes [2]. In this work, a novel method for preparing YSZ microtubes with 2–20 µm wall thickness and 10–100 µm diameter is described. This is an expansion upon the method previously described by the authors elsewhere [3, 4]. Ionic conductivity of materials is measured, as well as a single tube based fuel cell is constructed and tested. Open circuit voltage (OCV) values of the system are in the range from 1.03 to 0.88 V at 600–800 °C, which are close to the accepted values for YSZ based SOFCs [5].

References

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