Low Cost $La_{0.75}Sr_{0.2}MnO_3$ Cathode Material with Excellent Electrochemical Properties

Evelyn Proß[1], Jörg Laube[1], Axel C. Müller[2], André Weber[2], Ellen Ivers-Tiffée[2]

[1]H.C. Starck GmbH, Laufenburg, Germany
[2] Institut für Werkstoffe der Elektrotechnik (IWE), Universität Karlsruhe (TH), Adenauerring 20b, D-76131 Karlsruhe, Germany

The main objectives of H.C. Starck's internal development program for powders used in SOFC applications are to meet the cost targets of the customers as well as the performance requirements during operation.

An evaluation of existing powder production processes was made using the criteria costs, powder qualities, upscale potential and ecological aspects. Solid phase reaction was selected as the most promising method to produce (La,Sr)MnO_3 (LSM) and other perovskite-type powders for the application in SOFCs.

Optimisation of the powder engineering process resulted in very homogenous powders with good crystallographic properties. The primary particle size can be adapted to customers requirements in the range of some micrometers down to submicron powders. Additionally, spray dried agglomerates can be offered for a better handling of the powders.

Electrochemical performance tests of electrolyte supported single cells with cathodes based on LSM-powders from H.C. Starck were conducted at the IWE, Universität Karlsruhe (TH).

Fig. 1 shows the particle size distribution, the composition analyzed by XRFS and the major impurities analyzed by AAS of the used $La_{0.75}Sr_{0.2}MnO_3$-powder.

The morphological properties of this powder were adapted for the preparation of the cathode screen printing paste. Therefore well established fabrication routines could be applied at the IWE without any adaptation. The sintered cathodes exhibited a homogenous microstructure and excellent contact to the electrolyte (Fig. 2).

The single cells were characterized with respect to performance and long term behavior (> 1000 h) including load and thermal cycling. As can be seen in Fig. 3, current densities of 0.18 A/cm^2 (750°C), 0.43 A/cm^2 (850°C) and 0.7 A/cm^2 (950°C) were realized at a cell voltage of 0.7 V. The long term stability and thermocycling behavior was acceptable for mono-layer cathodes, performance and degradation were in good agreement with the standard type cathode compositions and microstructures.

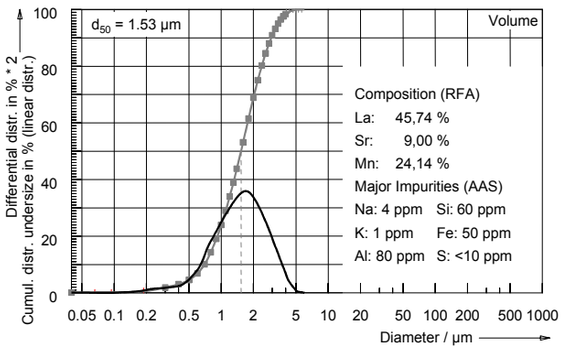

Figure 1 - Particle size distribution, composition and major impurities of the LSM-powder.

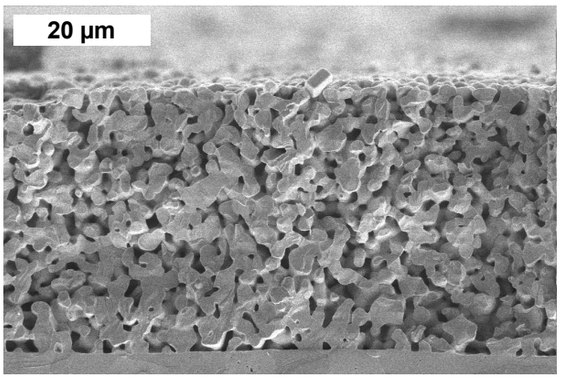

Figure 2 – Microstructure of the screen printed cathode layer (cross section).

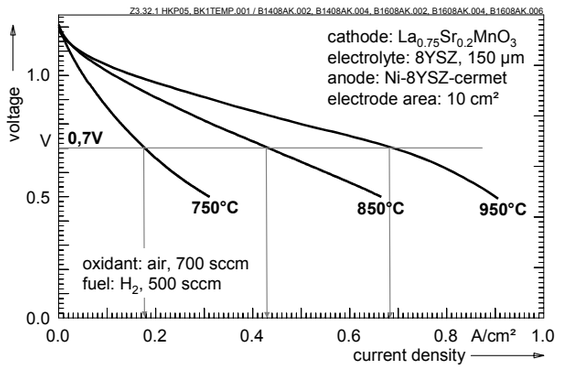

Figure 3 – I/V characteristics of electrolyte supported single cells at 750, 850 and 950 °C.