

invention to the specific form disclosed, but, on the contrary, the invention is to cover all modifications, alternative constructions, and equivalents falling within the spirit and scope of the invention as defined in the claims.

The following description provides information related to one proposed cell configuration and preparation conditions for the stable LSCF cells. While this example is set forth, it is to be distinctly understood that the invention is not limited thereto, but maybe variously alternatively configured according to the needs and necessities of the user.

Referring now to FIGS. 1-7, a variety of views of the present invention and various performance characteristics thereof are shown. Referring first now to FIG. 1. FIG. 1 shows the cell configuration of an anode-supported LSCF-based SOFC. This SOFC fuel cell contains an anode 12, in this embodiment a Ni—YSZ anode, an electrolyte layer 14, an interlayer 16, a cathode 18, and a metallization layer 20 all stacked together. The interlayer 16 placed between the cathode 18 and the electrolyte prevents any reactions between them.

Cathode 18 is usually screen-printed on top of interlayer using a cathode paste that may or may not contain pore formers. After firing the cathode layer, the metallization layer (usually grid form) is also screen-printed on the cathode and then fired. This metallization layer is connected to the interconnects in order to supply the electrons to the cathode.

In this embodiment of the invention, the metallization layer 20 provides greater than 90 percent coverage over the cathode 18 and has a thickness ranging between 2~20 μm on an LSCF cathode 18 having a thickness generally between 2~80 μm . Preferably the metallization layer is made from a noble metal material such as Ag, however other metals, and other materials such as various ceramics may also be utilized in accordance to the specific needs and necessities of the user. The cathode is formed utilizing a firing temperature between 950~1100° C. and connected with a paste having a pore former having 0~30 vol % with respect to the volume of LSCF in the cathode forming paste.

FIG. 2 shows a comparison of the electrochemical performance of the LSCF cells with different metallization layers. This figure shows that the stability of LSCF cells was greatly improved by using a fully covered metallization layer described above as compared to a cell with a grid. FIG. 3 shows the effects of cathode thickness on the stability of the LSCF cells with fully covered metallization. The thicker cathode revealed more stable performance, although the initial power decreased with thickness of the cathode. Other factors such as firing temperature of cathode layer (FIG. 4) and amount of pore former in the paste (FIG. 5) also influenced the stability of fully covered LSCF cells. FIG. 6 shows the long term performance of a fully covered LSCF cell, made according to the parameters set forth above. This cell revealed no degradation in power up to 2000 hrs of constant operation.

The degradation rate of the LSCF cathode has been determined to be closely related to the cell configuration and metallization as well as firing conditions, which influences the electrical conductivity and oxygen supply to the cathode. This embodiment optimized these variables to achieve stable performance of LSCF cathodes over 2000 hrs. FIG. 7 shows

the SEM micrographs of typical microstructures of a degraded cell and a stable cell (refer to (a) and (b), respectively). The stable cell contains microcracks in a cathode layer with 100~200 μm spacing. These microcracks help to relieve the stress caused by the thermal expansion mismatch between a SDC interlayer and a LSCF cathode layer and improve the oxygen diffusion to the cathode. Various modifications to the cathode thickness, the cathode firing temperature, the use of pore former influence the development of this microstructure.

This configuration enables us to use the cathode for SOFC applications that require a long operating time without experiencing performance degradation, such auxiliary power supplies for automotive and residential power sources. While various preferred embodiments of the invention are shown and described, it is to be distinctly understood that this invention is not limited thereto but may be variously embodied to practice within the scope of the following claims. From the foregoing description, it will be apparent that various changes may be made without departing from the spirit and scope of the invention as defined by the following claims.

What is claimed is:

1. A cathode for use in a solid oxide fuel cell comprising a cathode layer possessing thermal expansion mismatch with an interlayer, wherein the cathode layer contains microcracks forming cathode islands, and a metallization layer covering more than 90 percent of said cathode.
2. The cathode of claim 1 wherein the cathode layer comprises lanthanum strontium cobalt iron oxide.
3. The cathode of claim 2 wherein said cathode has a porosity of between 0-30 volume percent.
4. The cathode of claim 2 wherein said metallization layer comprises at least one material selected from the group consisting of noble metals and alloys thereof.
5. The cathode of claim 4 wherein said noble metal is Ag.
6. The cathode of claim 5 wherein said alloys are Ag alloys.
7. The cathode of claim 6 wherein said alloy is a Ag:Pd alloy.
8. The cathode of claim 2 wherein said cathode has a thickness ranging from between 2~80 μm .
9. The cathode of claim 2 wherein said metallization layer has a thickness of between 10 and 25 percent of the thickness of the cathode.
10. The cathode of claim 2 wherein said cathode is formed by heating of a paste at a temperature between 950~1100° C.
11. The cathode of claim 10 wherein the paste has a pore former having 0~30 vol % with respect to the volume of lanthanum strontium cobalt iron oxide in the cathode forming paste.
12. The cathode of claim 2 wherein the microcracks have 100~200 μm spacing.
13. The cathode of claim 2 wherein modification of fabrication parameters including thickness, firing temperature, and pore former allows formation of the microcracks.
14. The cathode of claim 2 wherein use of patterned screens or deposition of disconnected islands of cathode materials allows simulation of a microstructure of the microcracks.

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