Supporting Information

Enhanced Coking Tolerance of MgO-modified Ni Cermet Anode for Hydrocarbon Fueled Solid Oxide Fuel Cells

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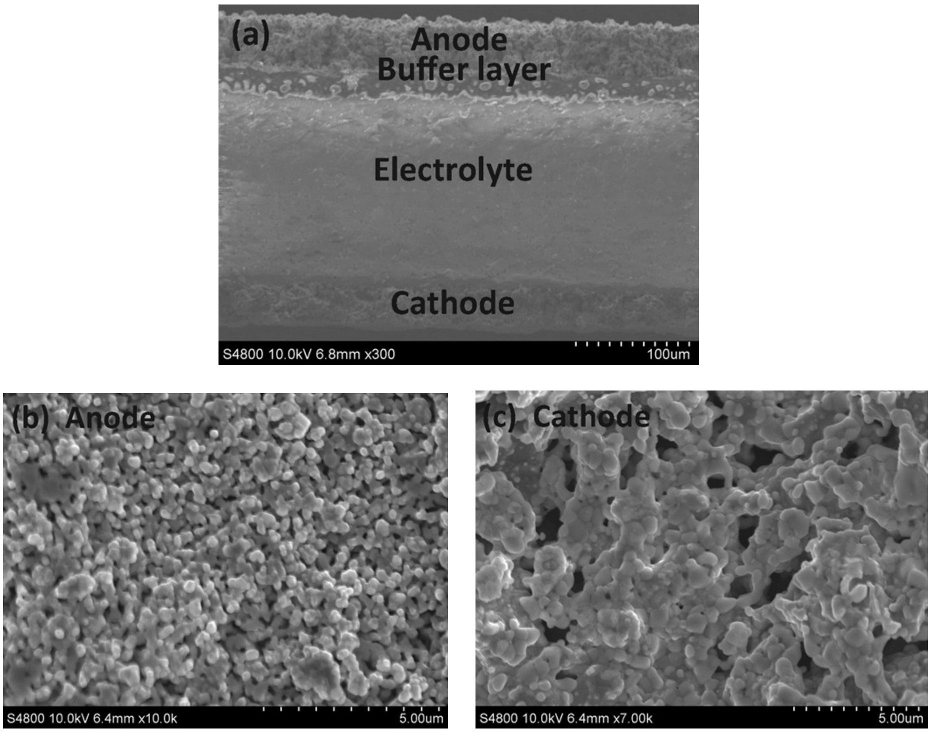

Figure S1. SEM images of the (a) Cross-section area, (b) anode surface and (c) cathode surface of a single cell with MgO modified Ni-SDC anode. Both of the anode and cathode are porous and about 35um in thickness. The electrolyte is dense (>99%) and about 220um in thickness.

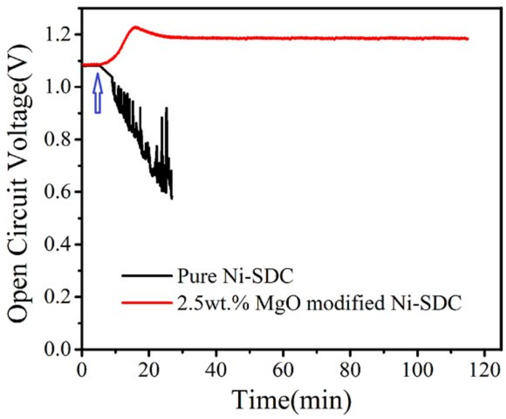

Figure S2. Open circuit voltage (OCV) of single cells with pure Ni-SDC anode and 2.5wt.%MgO modified Ni-SDC anode tested from humidified H_2 to CH_4 at 800℃. The blue arrow indicates the fuel was switched from humidified H_2 to CH_4. The OCV of the cell with pure Ni-SDC anode drops dramatically in 20 minutes, while it remains at about 1.18V for the cell with MgO modified Ni-SDC anode for at least 120 minutes. It reveals that the addition of 2.5wt.%MgO can prominently improve the electrochemical performance of traditional Ni cermet anode.

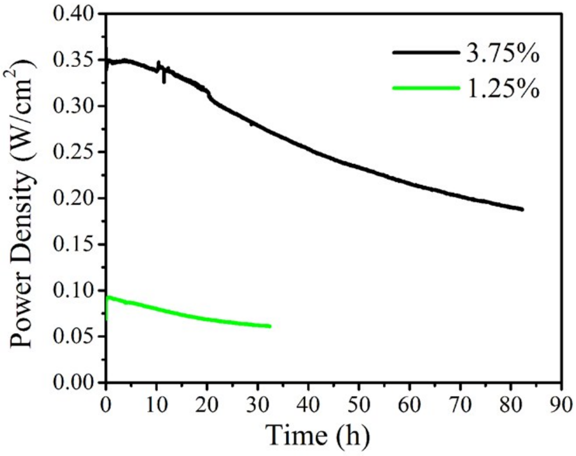

Figure S3. Long-term stability of single cells with 1.25wt.% and 3.75wt.% MgO modified Ni-SDC anode operated at 0.8V in humidified CH_4 at 800°C. The cell with loading of 1.25wt.%MgO exhibits lower power density in comparison with the cell with MgO loading of 3.75wt.%. However, both cells present lower durability compared to the cell with the MgO loading of 2.5wt.%, which is probably due to that excess amount of MgO cover the active sites of Ni cermet anode.

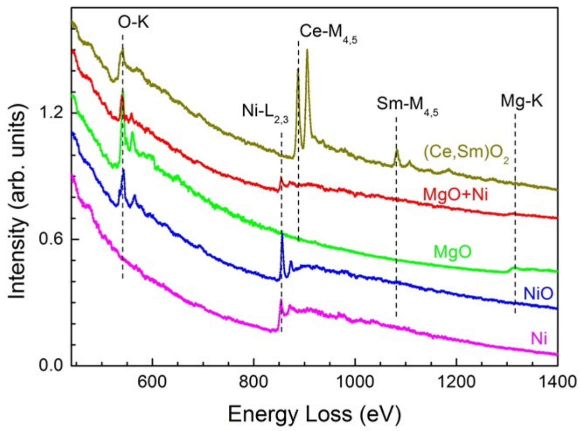

Figure S4. EELS spectra of the particles. Typical EELS spectra taken from the $(Ce,Sm)O_2$ (dark yellow), MgO (green), NiO (blue), and Ni (magneta) particles, and the overlap of MgO and Ni particles (red). The dashed lines indicate the O-K, Ni-$L_{2,3}$, Ce $M_{4,5}$, Sm $M_{4,5}$, and Mg-K edges. These results further clarify the chemical composition of the final cermet anode.

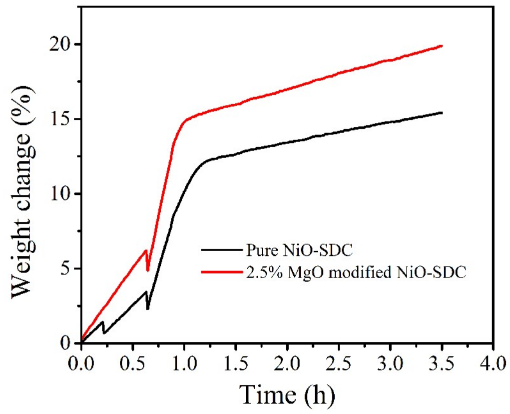

Figure S5. Typical thermogravimetric (TG) traces for pure and MgO modified Ni/SDC powder samples in wet nitrogen with 3v%H_2O at 800°C. The weight change of 2.5%MgO-Ni/SDC powder is more than that of pure NiO/SDC powder, which demonstrates that the MgO has a higher hydroscopicity.

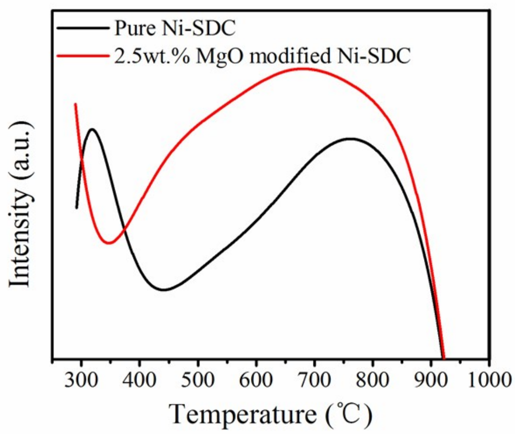

Figure S6. Temperature programmed desorption of CO_2 (CO_2-TPD) curves of the 2.5wt.%MgO modified and pure Ni-SDC powders. The peak area is related to the amount of the carbonates formed. It reveals that the adsorption capability of the 2.5wt.%MgO modified Ni-SDC powder is larger than that of pure Ni-SDC powder. Moreover, the addition of 2.5wt.%MgO decreases the temperature of peak desorption rate from 780°C to 680°C. It further suggests that MgO nanoparticles on the surface of Ni cermet favours capture CO_2.