Microstructure And Chemistry Of Ni/YSZ Anode For Cells Operated In H_2, Syngas And Syngas Containing PH_3

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In this study we report the microstructural and chemical evolution of anode grain boundaries and triple phase boundary (TPB) junctions of the Ni/YSZ anode support solid oxide fuel cells. A NiO phase was found to develop along the Ni/YSZ interfaces extending to TPBs in the operated cells. The thickness of the NiO ribbon phase remains constant at ~10 nm in hydrogen for operating durations up to 540 h. When operating on synthesis gas, an increase in NiO interphase thickness was observed from ~15 nm for 24 h of operation up to 60 nm for 550 h of operation. YSZ phases are observed to be stable in H_2 over 540 h operation. However, for the cell operated in syngas for 550 h, a 5-10 nm tetragonal YSZ (*t*-YSZ) interfacial layer was identified that originated from the Ni/YSZ interfaces. Yttrium seems to segregate to the interfaces during operation, leading to the formation of *t*-YSZ in the Y-depleted regions.

For the cells operated in syngas containing PH_3, the migration and redistribution of Y seem to be more significant. After operated in syngas containing 10 ppm PH_3 for 110 h, the YSZ shows a distinct yttrium depletion ribbon region and results in a 10-15 nm interfacial *t*-YSZ layer by the Ni/YSZ interface. Furthermore, TEM imaging and EDS reveals the existence of Y-P-O precipitates in the size of ~ 100 nm that formed after operation and the Y-P-O precipitates preferentially precipitated at the YSZ/YSZ/Ni triple-grain junctions.

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