

Project Report 2033



NTN Composite Interconnect Testing

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Objectives: short, medium and long term

The main objective of this investigation was to study the behaviour of a novel interconnect material for SOFC systems, in long-term tests in dual atmosphere at high temperature (800°C). This is a two phase composite (cermet), called NTN, manufactured by SolidCell (U.S.A.) and consisting of Ni as the metal phase and a TiO₂-Nb₂O₅ framework as the oxide phase. The investigation aimed to analyze the effects of the typical SOFCs operative conditions on this material, together with its physical and chemical compatibility with LSM (Lanthanum Strontium Manganite), a material used as a cathode in SOFCs. This will allow to point out criticalities in order to tailor the material to be more resistant to oxidation, to improve its chemical stability and its cost effectiveness.

Brief summary of work carried out

Samples of pure NTN and samples of NTN with an LSM (Lanthanum Strontium Manganite) cathode layer deposited on it have been studied in long-term tests under dual atmosphere (H₂/air) and high temperature, simulating the typical SOFC operative conditions, up to 500 h. Pre and post-mortem analysis have been performed by means of Raman spectroscopy, XRD and SEM-EDX techniques in order to evaluate morphological modifications, corrosion effects, and chemical interactions between NTN and the cathodic material. Moreover, EIS (Electrochemical Impedance Spectroscopy) measurements have been carried, monitoring the Area Specific Resistance (ASR) variations with time.

Main achievements intended for publication

NTN samples tested in dual atmosphere showed an unexpected high value of ASR. By SEM/EDX and XRD analysis, a nickel oxide phase was found to form on the surface exposed to air, due to the migration of Ni from the bulk of the sample to the surface. The formation of a nickel oxide layer may impede to some extent the conduction of electrons, explaining ASR values. Micro-Raman measurements on the cross section of tested samples, both uncoated and LSM-coated samples, revealed the formation of a NiTiO₃ phase beneath the NiO formed on the surface. Due to its spatial resolution, micro-Raman spectroscopy resulted the only technique able to identify the local formation of NiTiO₃. Diffusion of cathodic element (La and Sr) into the bulk of the NTN occurred, but no other modifications, such as formation of other phases involving cathodic elements, were detected in the oxide structure of the NTN samples. Diffusion of cathodic elements does not seem to affect the chemical and structural stability of the material.

Difficulties encountered

Identification of the phases from the Raman spectra was difficult due to the unexpected formation of NiTiO₃ formation.

Further comments

Further investigations, such as longer tests in dual atmosphere with more NTN samples, would be helpful to confirm and better understand the Ni oxidation behavior and the formation of NiTiO₃ on the air exposed surface, in order to limit or impede this undesired phenomena.