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An Investigation of Oxygen Reduction Reaction on Porous $(La_{0.85}Sr_{0.15})_{0.9}MnO_3$ Electrode for Solid Oxide Fuel Cell by Ac-Impedance Analysis

교류 임피던스 분석을 통한 고체 산화물 연료 전지용 다공성 $(La_{0.85}Sr_{0.15})_{0.9}MnO_3$ 전극에서의 산소 환원 반응에 대한 연구

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Oxygen reduction reaction on porous $(La_{0.85}Sr_{0.15})_{0.9}MnO_3$ (LSM) electrode was investigated by using ac-impedance spectroscopy. The LSM electrodes with various porosities were coated on the yttria-stabilised zirconia by screen printing method and then they were sintered at 1200 °C for 2 h in air. The measured ac-impedance spectrum simply consisted of two separated arcs in the high and low frequency ranges which are associated with the charge transfer reaction at the three-phase boundary and the oxygen diffusion reaction on the LSM surface, respectively. When the electrode was previously subjected to the cathodic polarisation over 13 h, however, it was found that the ac-impedance spectrum exhibited a Warburg behaviour at high frequencies indicating the semi-infinite diffusion process, followed by a depressed arc for the charge transfer reaction at low frequencies. From the results, it was recognised that during the preceding cathodic polarisation the reduction reaction of Mn^{3+} to Mn^{2+} partially occurs at the electrode surface, leading to the formation of oxygen vacancies, and hence diffusion of oxygen vacancies in the LSM electrode manifests itself as a rate-determining step of oxygen reduction reaction. The ac-impedance spectra measured at various temperatures and oxygen partial pressures were quantitatively analysed on the basis of the modified transmission line that has a complex network of distributed resistive and constant phase elements.

References

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