COMBINED OF COMPLEX NONLINEAR LEAST SQUARES (CNLS) & DISTRIBUTION OF RELAXATION TIMES (DRT) STUDY OF LSCF CATHODE THIN FILM WITH PCFC ELECTROLYTE

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ABSTRACT

Combined of Complex Nonlinear Least Squares (CNLS) & Distribution of Relaxation Times (DRT) Study of LSCF Cathode Thin Film with PCFC Electrolyte

This research investigated the temperature dependent performance of Lanthanum Strontium Cobalt Ferrite (LSCF) cathode on Barium Cerium Zirconate Yttrium (BCZY) electrolyte for protonic ceramic fuel cells (PCFC). The measurements of electrochemical impedance spectroscopy were obtained at 700°C, 750°C and 800°C, and data were analyzed using CNLS fitting and DRT methods. The material exhibited relatively high resistances (R_s=10.7 Ωcm², R_p=140 Ωcm²) and moderate conductivity (0.489 S/m) at 700°C, and DRT indicated broad peaks indicating slower processes. Performance was much improved at 750°C, where resistances decreased (R_s=8.0 Ωcm², R_p=0.55 Ωcm²) and conductivity was 0.654 S/m, with sharper DRT peaks showing faster reactions. Optimum performance was at 800°C, with lowest resistances (R_s=7.75 Ωcm², R_p=0.54 Ωcm²), highest conductivity (0.675 S/m) and sharper DRT peaks confirming faster reaction kinetics. These results clearly demonstrate that higher temperatures enhance the electrochemical activity of the material by reducing resistances and enhancing proton conductivity. The study validates LSCF as an optimum cathode material for intermediate temperature fuel cell application, with the integrated CNLS-DRT analysis offering comprehensive insight into the temperature dependent behavior of the symmetrical cell.

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