行政院原子能委員會

委託研究計畫研究報告

研究 SOFC 系統模擬分析技術

SOFC System Simulation and Analysis Technology

計畫編號：952001INER043

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中文摘要

本年度計畫以計算熱流合併電化學反應模擬 5 kW SOFC 展示系統，解析單片電池及電池堆之穩態及暫態速度、溫度、濃度、電流場及電化學性能，並以實驗數據驗證 CFD 程式之準確性。研究重點為核研所自行研製組裝之 SOFC 系統，故依設計規格從電解質、多孔介質、流道、連接板、單室電池、至多室電池堆、再加上進排氣系統，完整描述 SOFC 內部無法看到之細節輸送現象及與整體性能關聯分析，其中電解質部份加入分子動態模擬(Molecular Dynamics, MD)，以求最佳化學結構組成。最終並以 INER 實驗數據驗証電腦模擬之準確性。

Abstract

This project simulates the electrochemical performance of the 5kW SOFC system built-up by the INER. It starts from the planar single cell assembly to the whole fuel cell stack, including the inlet and exhaust systems. The steady and transient velocity, temperature, concentration, and current fields are the major investigated transport phenomena. These are extremely difficult to be visualized by experiments. However, the computational fluid dynamics (CFD) technique is able to show the detailed flow fields which were influenced by the geometry and specification design of the diffusion layer, flow channel, stack and inlet/exhaust systems. On the electrolyte design, we have implemented the CFD code with part of the molecular dynamics (MD) technique to study the optimal chemical composition and molecular structure. The whole simulation results are validated with the experimental results carried out by the INER.