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固態氧化物燃料電池系統之關鍵組件-尾氣續燃器設計(II)

Critical Component Development on Solid Oxide Fuel Cell System-Sequential Burner Design(II)

計畫編號：95 2001 INER050

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固態氧化物燃料電池系統之關鍵組件-尾氣續燃器設計(II)

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中文摘要

本研究主要目的是設計一具符合燃燒核研所目前固態氧化物燃料電池（Solid Oxide Fuel Cell, SOFC）實體的出口排放剩餘氣體條件的尾氣續燃器（Sequential Burner, SeqB），而由於 SeqB 裡的燃燒條件都是接近甚至低於貧油極限（Lean Combustion Limit），因此吾人採以一幅流式渦漩器及突張式設計作為 SeqB 的主要構型，主要希望藉由創造迴流區來達到 SeqB 穩焰的效果，而吾人也透過實際 SeqB 出口排氣成份量測來驗證 SeqB 燃燒性能。

由於實際 SOFC 出口溫度約在 1100 K，因此為了有效模擬出趨近真實 SOFC 出口的氣流條件，吾人在本研究以三套陶瓷纖維電熱系統及一預熱燃燒室來模擬此條件，可以成功的模擬核研所 SOFC 出口條件，其中溫度加熱至 1100±30 K，各成份之流量控制在誤差 6 %之內，其實驗數據與理論計算的結果相符；而在進行氫氣減量測試時本 SeqB 內的氫氣流量可低至一般氫氣可燃極限的 1/10 仍不至於熄滅，在 SeqB 排氣成份的理論推算及實際量測中也可以得知 NO_x 的排放量是隨著 SeqB 工作溫度的升高而攀升，而在 SeqB 出口端氫氣及一氧化碳的含量也呈現極低的狀況，由此也可得知在 SeqB 內部的燃燒反應應該是十分完全的。

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Abstract

The motivation of this study is to design a sequential burner (SeqB) to match the requirements of Institute of Nuclear Energy Research (INER) for remained exhaust from solid oxide fuel cell (SOFC). Because the combustion condition of SeqB is nearly the lean combustion limit, a radial swirler and the sudden enlarge geometry are regarded as main designs feature of SeqB. Furthermore, through the measurements of emission at the SeqB exit, combustion performance of SeqB is verified as well.

For the SOFC exit temperature is about 1100 K, there are three sets of Ceramic Fiber Heater System and one preheater to effectively simulate the airflow condition of full-scale SOFC, and it is successfully reaching the exit condition of INER. The temperature was risen to 1100±30 K, and the error flow rate of each composition is below 6%. The experimental results consequently are consistent with our theoretical calculation. It is found that 1/10 equivalence ratio of hydrogen lean combustion limit can still maintain the combustion inside of SeqB. From theoretical calculation of exhaust composition within SeqB and experiment, it is found that the amount of NO_x is increasing with the rising working temperature of SeqB. Meanwhile, the concentration of carbon monoxide and hydrogen is extremely low at the exit of SeqB; therefore the combustion should be reacted almost completely according to this result.