

質子傳輸型固態氧化物電解電池(P-SOEC)之關鍵技術開發

執行單位

國立中央大學

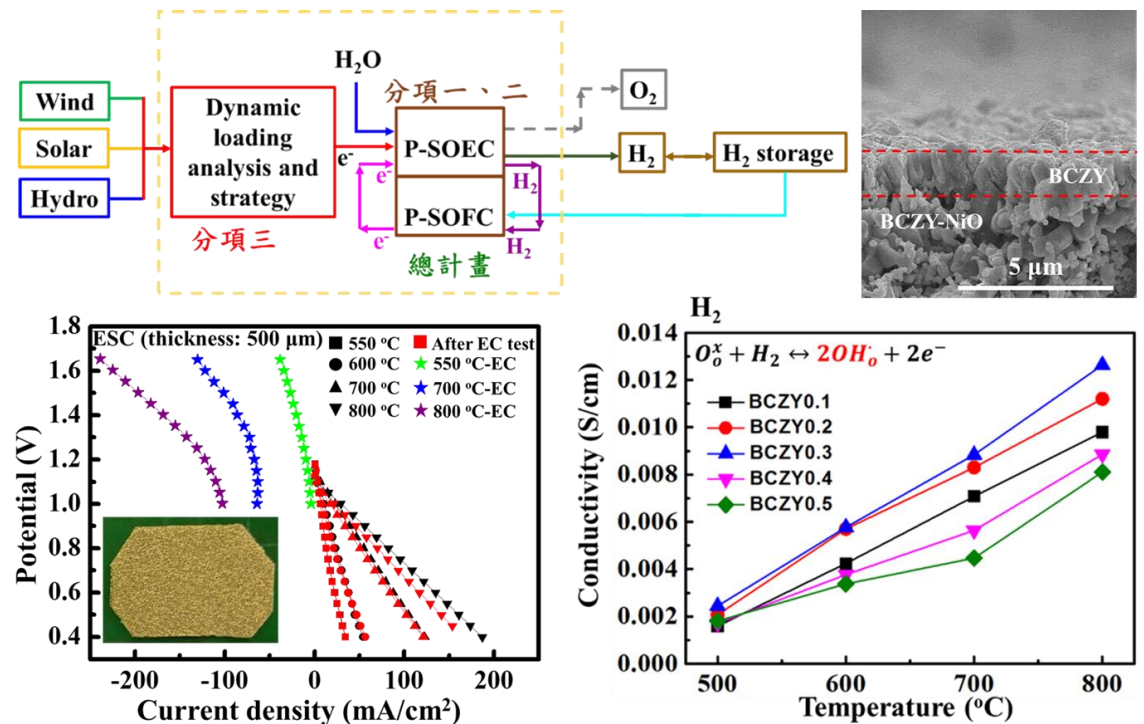
計畫主持人

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- 本計畫研發的P-SOEC為一新穎電轉氣(Power to gas)技術，目的在於將綠電(太陽能、風能)所產之無法併網的電力，利用燃料電池進行逆反應產氫，將電力以氫氣的形態進行儲存，解決綠電無法併網之困境，以達到儲能之目的。

專利：

1. SOFC製程專利，1件已獲證(用於固態氧化物燃料電池之電解質製備方法，中華民國專利第I616423號)、2件申請中(固態氧化物燃料電池之電解質製備方法、應用於固態氧化物燃料電池之奈米纖維陽極功能層)。
2. 燃料電池系統專利，1件已獲證(質子交換膜燃料電池I587564)、1件申請中(Fuel Cell System and Startup and shutdown Method Therefor，美國專利申請號US 15/620,047)。



- 本產學合作計畫於106-107年開發可進行正逆雙向反應之高穩定性質子傳輸型固態氧化物電解電池(Proton-conducting solid oxide electrolyzer cells, P-SOEC)材料，同時掌握P-SOEC正逆反應轉換之關鍵操作技術。計畫核心技術包含：(1)關鍵電解質新穎製程；(2)氫氣電極膜層設計；(3)空氣電極材料控制；(4)單電池整合製程；(5)SOEC模擬分析。
- 所開發P-SOFC性能在600°C達125.5 mW/cm²。氫氣電極熱膨脹係數16.9*10⁻⁶/K、空氣電極17.2*10⁻⁶/K，與電解質(12.4*10⁻⁶/K)之熱機械匹配性佳。
- 建立P-SOEC單電池標準化測試與性能評估平台。電流密度100 mA/cm² @1.6V, 700 °C，單位面積產氫率10 cc/h/cm² @550 °C。
- 所開發之P-SOEC電解質、電極，可技轉至合作之九豪精密陶瓷公司進行單電池片量產。
- 與合作廠商亞洲氢能公司共同建置之SOEC量測系統及模擬系統，可提供中高溫SOEC系統整合經驗，有助未來P-SOEC電池堆模組商業化。

Development of key technologies for proton-conducting solid oxide electrolyzer cells

Execution Unit

National Central University

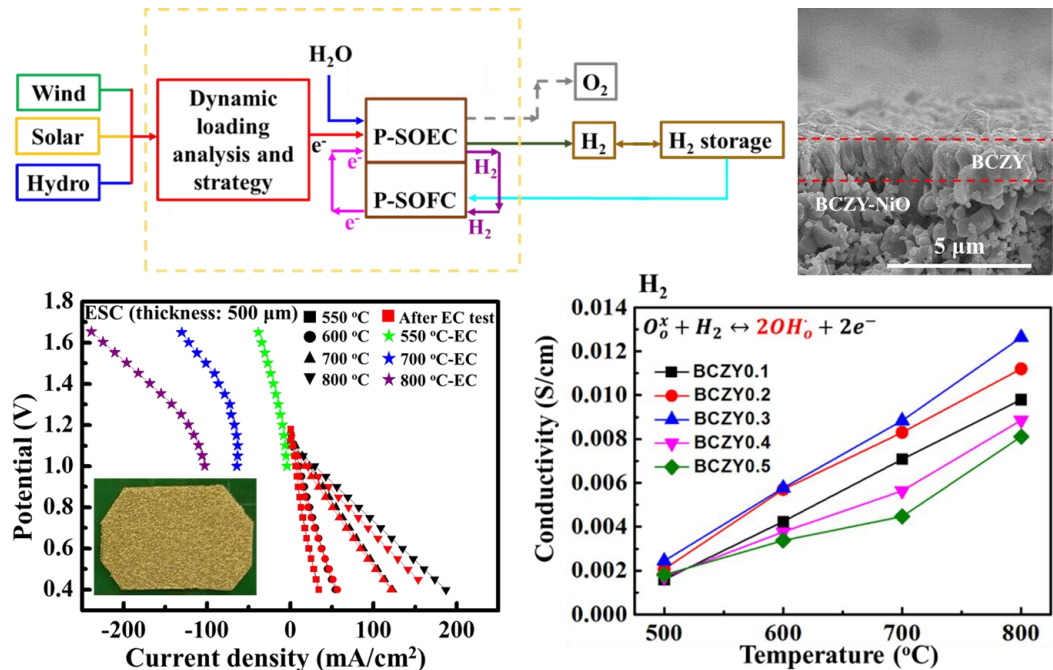
Project Director

Prof. Sheng-Wei Lee

- The Power-to-Gas technology links the power grid with the gas grid by converting surplus power into a grid compatible gas. P-SOECs can efficiently convert and store surplus VRE(variable renewable energy) electricity in the form of H_2 through steam electrolysis; thereby offering a promising pathway for accommodating the intermittence of VRE.

Patents:

- SOFC fabrication method: (1) Preparation method of electrolytes for solid oxide fuel cells (No. I616423), (2) Synthesis method for SOFC electrolyte, (3) Fabrication of nanofibers and SOFC anode functional layers.
- Fuel cell system: (1) Proton exchange membrane fuel cell (No. I587564), (2) Fuel cell system and startup and shutdown method therefor.



- This project focuses on the development of key technologies for proton-conducting solid oxide electrolyzer cells (P-SOECs). There are 3 sub-projects in this project: (1) technical development of key electrolytes for P-SOECs, (2) development of key electrode materials for integration with the key electrolytes, (3) system modeling and simulation. This research is a joint effort among two universities (National Central University and Yuan Ze University) and two industrial partners (Leatec Fine Ceramics Ltd. Co. and Asia Hydrogen Energy Ltd. Co.) during the executive period of 2017~2018.
- The achievements of this project on the P-SOEC electrolyte and electrode will serve as important product for technology transfer to Leatec Fine Ceramics Company when Leatec invest their resources on the production of SOFC/SOEC single cells.
- The cooperation between Asia Hydrogen Energy Company on P-SOEC testing platform and simulation system will provide practical demonstration for integration of SOEC. In terms of market potential and industrial development, this project is expected to significantly advance the commercial development of Power-to-Gas technologies for green power generation.