

液流電池產業關鍵技術研發

執行單位

行政院原子能委員會核能研究所

計畫主持人

魏華洲

- 本計畫發展液流電池關鍵材料、電池模組及組件設計、儲能系統整合控制等核心技術，透過技術研發應用提升國產化材料特性，示範未來國內儲能應用情境，爭取國內業界共同合作開發，形成產業鏈，擴大研發成果及產業應用價值，以支持政府再生能源政策目標。

電池系統

- 多功能整合型液流電池模組
(中華民國發明專利第I525890號)
- 超音波檢測液流電池充電狀態裝置
(中華民國發明專利第I506292號)
(美國發明專利US9,406,962B2號)
- 利用電解液流體管路儲放電能之方法與結構
(中華民國發明專利第I509870號)
(美國發明專利US9608286B2號)
- 液流電池歧路電流阻抑裝置及其方法
(中華民國發明專利第I575807號)
(美國發明專利申請號14/696,556)
- 複合型線能路燈裝置
(中華民國發明專利申請號106121475)

電解液

- 高效率半鈦液流儲能電池
(中華民國發明專利第I525891號)
- 含混合鹵素與硫酸鈦電解液製備方法
(中華民國發明專利I583044號)

隔離膜

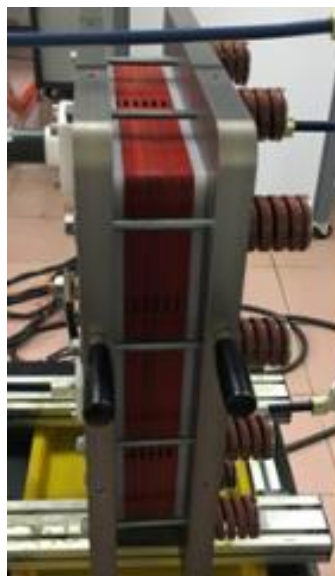
- 低成本隔離膜製法
(中華民國發明專利I591104號)(7/11)

碳氈

- 電化學氧化改質碳氈
(中華民國發明專利申請號103136208)
(美國發明專利申請號14/732,873)
- 添加CNT改質碳氈
(中華民國發明專利第I501455號)
(美國發明專利申請號14/266,945)
- 超音波震盪提升液流電池碳氈效能之方法
(中華民國發明專利申請號105115477)
(美國發明專利申請號15/396,897)
- 液流電池碳電極優化方法
(中華民國發明專利申請號106106825)

雙極板/流場板

- 液流電池之雙極板及其製作方法
(中華民國發明專利I575805號)
(美國發明專利申請號15/015,203)



新型高效能電池模組



永續綠能路燈

*紅色字體為106年申請專利；藍色字體為目前已取得專利(含底線為106年取得專利)

- 高效能關鍵材料研發，採用專有電極處理技術及優化操作條件，可維持高電流密度下能量效率>80%，充放電測試超過13000次仍維持穩定。相關核心技術應用於新一代高國產化高效能電池組，電流密度較第一代設計可提升2.5倍至100 mA/cm²，接近國際水準，有效提升液流電池儲能系統核心單元產業競爭力。
- 低成本隔離膜藉由核心改質技術，可提升效能，能量效率可達Nafion 117的90%以上，且價格僅為杜邦Nafion質子交換膜的20%，具有降低全鈦液流電池建置成本20%之潛力。
- 進行專利布局及分析，並取得12件國內及美國專利；106年爭取業界先期參與案一件，以拓展技術應用，簽約金額100萬元。
- 永續綠能路燈-結合計畫研發材料及控制技術驗證無需市電獨立運轉之管理系統，並獲106年國際發明獎金牌獎。

Research of Core Technology for Flow Battery Industrialization

Execution Unit

Institute of Nuclear Energy Research, Atomic Energy Council

Project Director

Wei, Hwa-Jou

- This project is focus on flow battery technology research and development, especial for novel materials, stack design and scale-up research for application. The prototype vanadium flow battery system will be integrated for with micro-grid or solar photovoltaic to study the performance and control logic of energy management. We expect to achieve the high power density of VRFB stack and cost effective for application.

Battery:

- MULTIFUNCTIONAL MODULE OF INTEGRATED FLOW BATTERY (TW I525890)
- Ultrasonic Device Detecting Charging / Discharging Status of Flow-Cell Pack (TW I506292; US9,406,962B2)
- Method of charging/discharging power through pipelines flown with electrolytes and apparatus using the same (US 9608286B2; TW I509870)
- Flow battery apparatus with shunted current repressed and method thereof (TW I575807; US 15/206,415)
- Hybrid Green-Energy Street Light Apparatus (TW 106121475)

Electrolyte:

- High-Performance Semi-Vanadium Flow Battery (TW I525891)
- Method of Fabricating Vanadium Electrolyte Containing Mixed Halogen and Sulfate (TW I583044)

Bipolar plate:

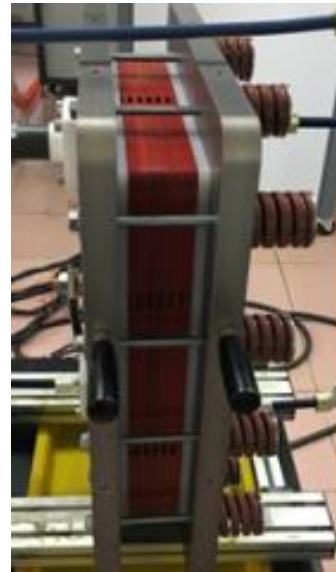
- Method of Fabricating Bipolar Plate of Flow Cell (TW I575805, US 15/015,203)

Membrane:

- Method of Fabricating Separation Film with Low Cost (TW I591104)

Carbon felt:

- Method of direct electrochemical oxidation for modifying carbon felts of flow battery (TW 103136208, US 14/732,873)
- Carbon felt with CNT added (TW I501455, US 14/266,945)
- Method of direct electrochemical oxidation for modifying carbon felts of flow battery (TW 105115477, US 15/396,897)
- Method of direct electrochemical oxidation for modifying carbon felts of flow battery (TW 106106825)



High efficiency battery module



VRFB street light

- Flow batteries with high current density ($>100 \text{ mA/cm}^2$), high energy efficiency ($>80\%$) and tough duration (>13000 cycles) have been achieved through the improvement of novel materials, such as special treatment of carbon felts, and premier tuning of operating conditions. It is approaching the level of present international VRFB skill.
- The special membranes we achieved are of lower cost, priced at about 20% of Nafion 117, with more than 90% energy efficiency referring to that of targeting Nafion.
- Dozen patents have been deployed and one joint company with one million NT dollars had invested to this project.
- The product of VRFB street-light under this project earned the award of gold medal of 2017 International Invention.