二氧化碳捕獲之創新型快速溫變吸脫附複合中空纖維管、模組與可調適型系統開發

執行單位	國立臺灣大學化學工程學系暨研究所	計畫主持人	童國倫; 陳誠亮; 吳嘉文

研發全球首創中空金屬「銅/不鏽鋼」纖維吸附器作為快速溫變吸脫附(RTSA)系統進行二氧化碳捕捉。吸附劑以易放大之塗佈方式「浸漬塗佈/熱電漿噴塗」成長於中空金屬纖維表面，搭配熱電漿噴塗觸媒賦予吸附器二氧化碳轉化功能。

二氧化碳捕獲用之管式膜氣凝膠改質技術

已於美國、台灣獲得發明專利：

美國：發明專利號 9561463

臺灣：發明專利號 I565681

專利獲2017匹茲堡發明競賽(INPEX)金牌，將更有助於未來此專利技術的推展與加速商業化。

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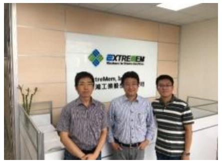

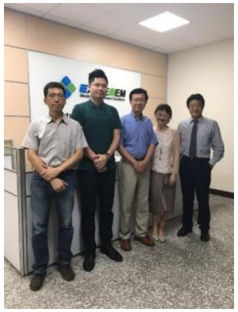

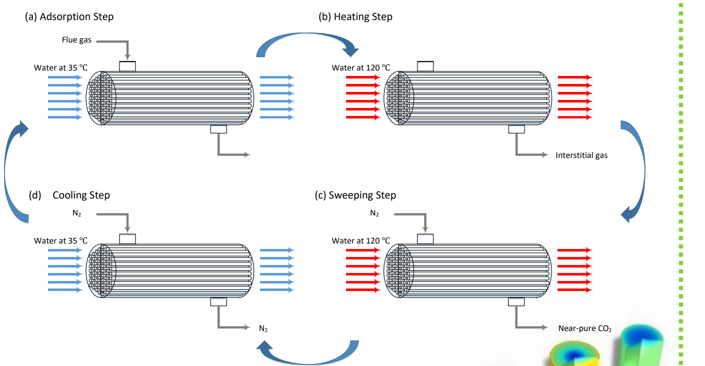

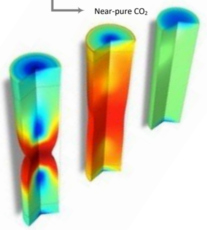

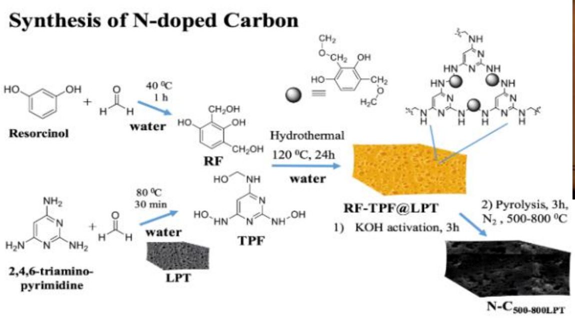

- 透過中空金屬纖維進行系統溫控不僅能有效提升熱效率，同時可對吸脫附與觸媒轉化效能進行優化，達到高效二氧化碳回收利用之目標。本團隊從材料、製程、封裝到程序化系統皆以可規模化角度進行設計，加速未來技術放大驗證與實廠化之可能。

- 在二氧化碳吸附材料開發開發的方面，本團隊成功研發纖維素轉換之氮元素混摻孔洞碳，與目前世界上常用的13X型沸石相比，在相當體積下，能提供高出50%之二氧化碳吸附能力(3.6 mmol/g @ 298K; 5.7 mmol/g @ 273K)，且能耗比傳統吸收操作低。在程序化系統方面，本團隊擁有世界頂尖之程序控制模擬技術。透過優化系統建立，可為各產業量身訂做減碳裝置，進而加速台灣相關企業符合減碳的要求。

- 掌握材料開發與製程關鍵，並搭配程序控制優化系統是此我們技術發展之核心，重新設計出新穎的高效二氧化碳吸附轉化器。目前相關技術已獲多項台美專利與國際獎項(2017匹茲堡發明獎INPEX金牌)，並逐步與產業和國際接軌。在國內由李長榮化工公司提撥研發基金共同進行實測，在國際合作方面與義大利國家研究委員會簽定“薄膜接觸器之材料與程序開發之前瞻研究”個跨國合作研究計畫。在新創公司方面，於2017年3月成立ExtreMem公司，資本額3000萬元。並成功技轉自學校之先期技術，該技術並於今年十二月獲2017年第十四屆國家新創獎-學研新創獎。公司營運分為四階段逐步建立公司的商業化技術，以製造循環經濟所需關鍵分離材料為核心，為我國發展循環經濟產業注入一股新血。

Innovative Rapid Temperature Swing Adsorption for Carbon Dioxide Capture : Development of Composite Hollow Fiber, Module and Tunable Systems

Execution Unit	NTU Chemical Engineering Department
Project Director	Kuo-Lun Tung; Cheng-Liang Chen; Chia-Wen (Kevin) Wu

Developing Innovative Hollow Metal Fiber Supported Sorbents into Rapid Temperature Swing Adsorption (HMFSS-RTSA) system for carbon dioxide capture. By using scalable coating techniques (dip coating/ thermal plasma spray), sorbents can finely attached on hollow metal surfaces. Furthermore, carbon dioxide conversion functions can occur on the sorbents by spraying catalysts via advanced thermal plasma spray method. As the result, integrated carbon capture and utilization system are achieved fulfilling circular economy goals.

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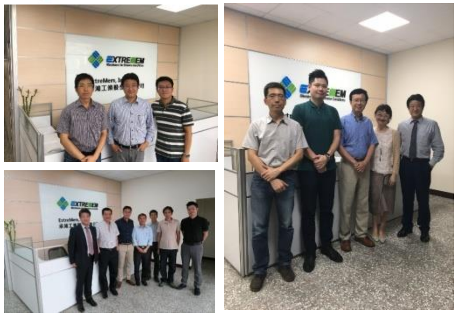

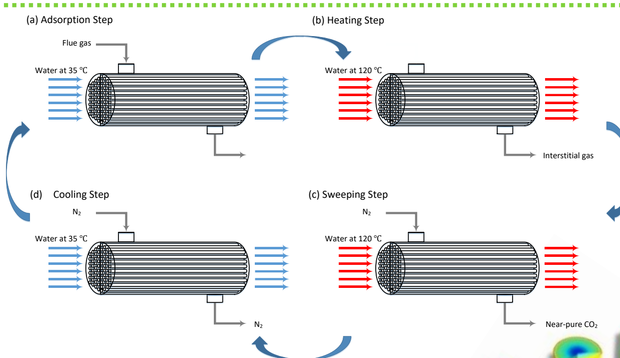

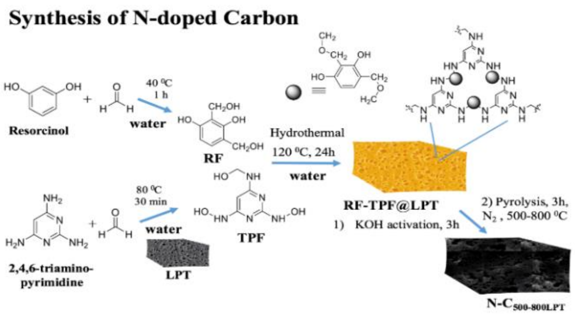

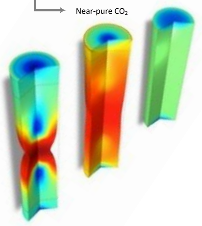

- Hollow Metal Fiber Supported Sorbent not only enhancing thermal efficiency of the system temperature control, but it can optimize the adsorption-desorption and catalyst conversion efficiencies, as well. This project is carried out by utilizing scalable materials, packaging and process design and thus, scale up process and model verification is being accelerated, making it feasible for industrial Applications.

- Concerning the improvement of carbon dioxide adsorbents, uur team has successfully synthesized Nitrogen-doped Adsorbents. The synthesized adsorbents has 50% higher capacity for CO_2 absorption and lower energy consumption vs commonly used absorbent (13X-type zeolities). Moreover, our team has the world's preeminent process control simulation techniques. Through the establishment of process optimization, it is possible to assemble custom carbon reduction devices for various industries, therefore ensuring the compliance of carbon reduction regulations of Taiwan-related enterprises

- Grasping the crucial techniques of material synthesis and process design, and integrating with process control optimization and designing novel CO_2 absorption conversion are our research core. Recently, our technologies have been granted several precious Taiwan-US patents and international awards (INPEX Gold Award 2017 Pittsburgh Invention Award), and gradually catching up with industry requirement and international standards. In the national industry cooperation, Li Changrong Chemical Company has allocated R & D Fund to stimulate this technology deployment. In the international collaboration, currently our team is conducting, "Advances in Membrane Contactors: From Materials to Process", a join-research project with the Italian National Research Council. In terms of startup company, ExtreMem was established in March 2017 with investment capital of 30 million Taiwan dollars. Extremem has successfully carried out technology transfer from academia to industry, in which it was granted 2017 national innovation award - academic research innovation award. Our business expansion in accomplishing technology commercialization is divided into four stages. Inventing key materials for separation process which needed for setting up circular economy is our company core objective which leads to the development of Taiwan Circular Economy Goals.