

鈣鈦礦太陽能電池製程與量產技術研發

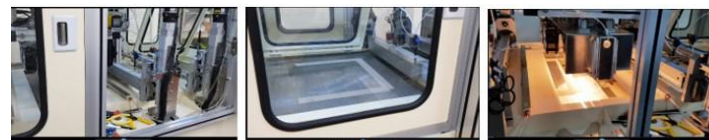
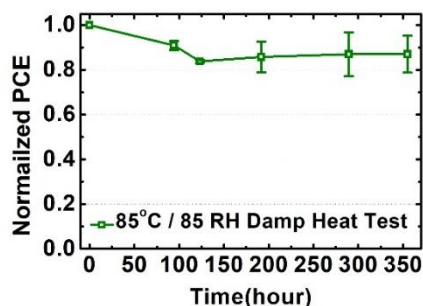
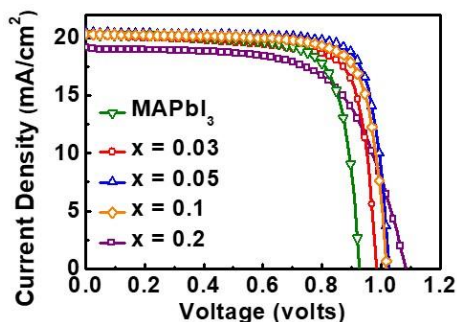
執行單位

台灣大學材料系、機械系、核能研究所、億尚精密、前創科技

計畫主持人

林唯芳、黃秉鈞、曹正熙、廖學中

- 本計畫開發大面積鈣鈦礦太陽能電池的量產技術，集材料、製程、機台等核心技術，產業化後可用於驅動耗能裝置室內光電轉換應用、室外發電型電廠應用，建築物整合發電應用，鈣鈦礦/矽晶疊層太陽能電池等多種用途。



(a)第一層：塗佈-停留(00:29)-熱處理(00:52)-原點



(b)第二層：塗佈(01:55)-停留(02:29)-熱處理(02:58)-原點



(c)第三層：塗佈(03:57)-停留(04:31)-熱處理(05:01)-原點



(d)第四層：塗佈(06:18)-停留(06:39)-熱處理(07:03)-原點

機台整體試車自動操作(2017/12/09): 8分鐘完成四層塗佈與熱處理製程

左: 大氣環境下，利用Cl摻雜，改善薄膜的成膜性以及降低薄膜粗糙度，製作成的元件效率，最高達 18.1%。右: 利用小面積元件進行高溫高濕85度/85相對溼度測試，目前已經測試到350小時，元件衰退小於10%，元件持續測試中



全尺度塗佈機外觀

- 本計畫結合產(億尚精密、前創科技)、學(台大材料系與機械系)、研(核能所)多方專長，開發大面積鈣鈦礦太陽電池的量產技術，集材料、製程、機台等核心技術。
- 全世界首團隊以量產型熱鑄法製程高效率鈣鈦太陽能電池達18.1%。
- 全世界首團隊以奈秒雷射進行高品質P1-P3鈣鈦礦模組化。
- 小面積元件封裝，高溫高濕85度/85相對溼度測試，350小時，元件效率衰退小於20%。
- 設計全世界第一台客製化鈣鈦礦生產機台，發包製造之尺度目前為全世界鈣鈦礦生產機台之最，包含全尺度量產機台、40cm鍍膜機，鈣鈦礦長晶快速熱處理機，可在八分鐘內自動製作四層薄膜，塗佈膜厚1~30 μm 。

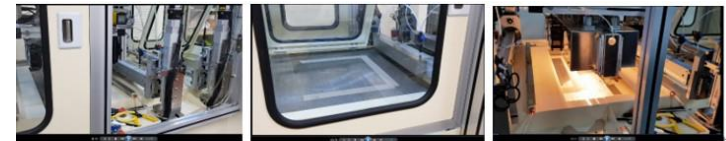
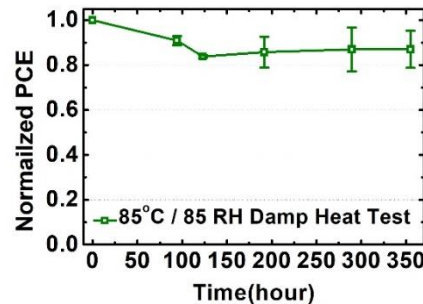
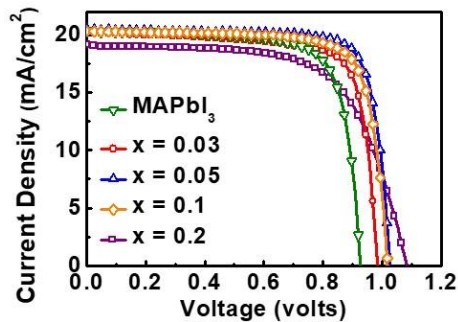
Development of mass production technology for perovskite solar cells

Execution Unit

National Taiwan University, Institute of Nuclear Energy Research, E-Sun, Co., Ltd.,
Frontmaterials Co., Ltd.

Project Director

Wei-Fang Su, Bin-Juine Huang, Cheng-Si Tsao, Hsueh-Chung Liao



Left: Current-Voltage of small area solar cells processed by chloride doping achieving 19.1% power conversion efficiency. Right: Damp heat (85°C/85RH%) accelerating test of solar cell over 350 hours with degradation < 20%.



Photos of full-scale slot die coating machine for perovskite solar cell

Test run of full-scale slot die coater showing the coating of four layers of perovskite solar cell within 8 minutes.

- A R&D from the upstream (materials, processing) to the downstream (equipment, mass production) is integrated to develop large-scale processing technology for perovskite solar cells.
- This is a multidisciplinary R&D project joined by: 1. University research groups: ME&MSE, 2. Organic photovoltaic (OPV) group of Institute of Nuclear Energy Research (INER) and 3. Industry: E-Sun Precision Industrial Co. Ltd. & FrontMaterials Co. Ltd.
- A perovskite solar cell with 18.1% power conversion efficiency solar has been achieved which was prepared by scalable processing technology and perovskite materials.
- A world leading modulation technology of laser scribing from P1-P3 has been established for perovskite solar modules.
- A stable perovskite solar cell was made and passed damp heat (85°C/85RH%) accelerating test for 350 hours with degradation < 20%.
- The world first full-scale (~40cm) processing machine for perovskite solar module, including slot-die coater and RTP processing, enabling the coating of four layers within 8 minutes and film thickness ~ 1~30µm