太陽光電技術發展與應用

執行單位	核能研究所	計畫主持人	洪慧芬

- 微型聚光型太陽電池模組係作為高效率太陽能發電站之用途，實驗室最佳效率為35.15%，以量產技術製造之模組其光電轉換效率為32.7%，在場址面積有限的環境中可提升發電量。本製程利用台灣LED技術優勢，將既有LED自動化技術應用至太陽能領域，有利於降低產業投資成本。

- 球透鏡固定裝置
- 太陽能接收器球透鏡封裝之方法及其結構
- 具有二次光學元件之太陽能接收器之封裝方式
- 高聚光太陽能電池模組框架組裝改良
- 太陽電池元件之封裝方法及其結構
- 太陽電池之電性檢測方法
- 聚光型太陽能模組及其對位裝置及對位方法

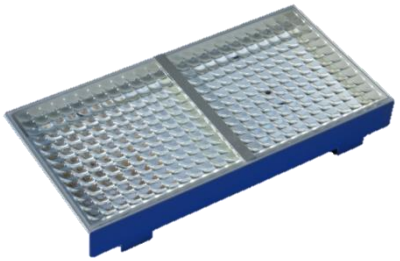

圖1 微型聚光型太陽電池模組實品圖

表1 以量產技術製作之模組電性

Irradiance	DNI(W/m²)	1000
Short Circuit Current	I_{SC} (A)	3.976
Open Circuit Voltage	V_{OC} (V)	12.62
Current at PMPP	I_{MPP} (A)	3.534
Voltage at PMPP	V_{MPP} (V)	10.66
Nominal Power	P_{MPP} (W)	37.66
Efficiency	η(%)	32.7
Temperature Coefficient	$\%_{rel}$/°C	-0.106
Aperture Area	cm²	1152

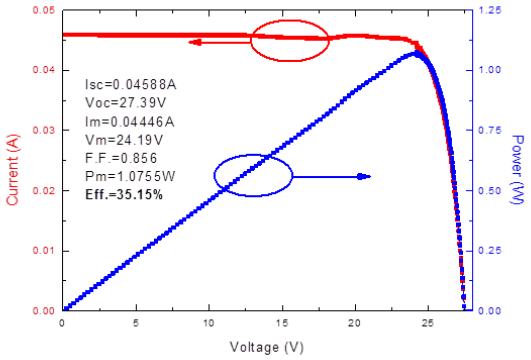

圖2 實驗室最佳效率電性圖

- 技術介紹：聚光型太陽電池模組技術，係利用光學元件將太陽光匯聚於太陽電池，聚光倍率達到千倍太陽光強度，可提高模組光電轉換效率，目前國際間實驗室的全尺寸模組(Full scale module)最高效率為38.9% (Soitec)。模組採用的III-V族多接面太陽電池，其理論效率值可高於60%，現階段發展至46%，因此呈現本項技術仍具有進一步提升的空間。
- 目前發展情況：核研所開發的微型聚光型太陽電池模組，實驗室最佳效率為35.15%，以量產技術製造之模組其戶外實測效率平均為32.7%。此外，目前核研所已成功將光學焦距由原先20公分縮小至6公分，並導入LED封裝技術，以提升模組自動化程度，有助於提升產率及降低投資成本。
- 獎項：

2014年台北國際發明暨技術交易展銀牌獎

2016年台北國際發明暨技術交易展金牌獎

2017年台北國際發明暨技術交易展銅牌獎

Photovoltaic technique development and applications

Execution Unit	Institute of Nuclear Research
Project Director	Dr. Hong, Hwen-Fen

- Micro concentrating photovoltaic module is used to a high efficiency solar power station. The best efficiency in laboratory of a CPV module is 35.15%, and which of a CPV module made by mass production process is 32.7%. CPV can generate more power in limited area. The investment of Micro CPV modules can be reduces by combining Taiwan LED mass production techniques.

- Fixing apparatus for ball lens
- Ball lens packaging method
- Method for packaging solar cell receiver having secondary optical elements
- Frame interior connectors for holding high- concentrated solar cells
- Method for Packaging Solar Cell Device and Structure Thereof
- Optical Inspection Method for Solar Cell
- Concentrator photovoltaic module and the alignment device and method thereof

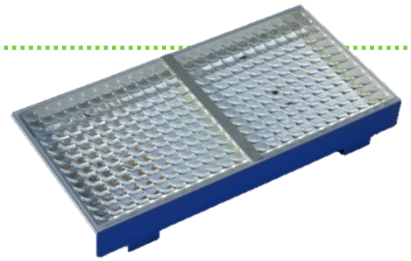

Fig. 1 a sample of Micro-CPV module

Sheet 1 Electric properties of a module made by production process

Irradiance	DNI(W/m²)	1000
Short Circuit Current	I_{SC} (A)	3.976
Open Circuit Voltage	V_{OC} (V)	12.62
Current at PMPP	I_{MPP} (A)	3.534
Voltage at PMPP	V_{MPP} (V)	10.66
Nominal Power	P_{MPP} (W)	37.66
Efficiency	η(%)	32.7
Temperature Coefficient	$\%_{rel}$/°C	-0.106
Aperture Area	cm²	1152

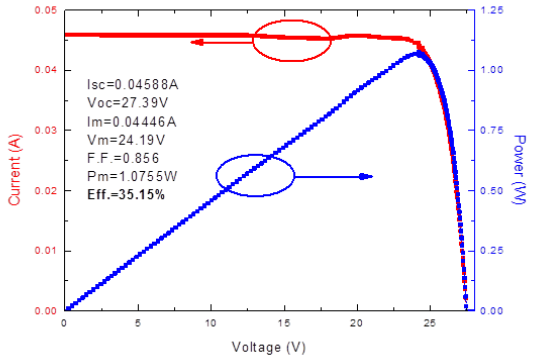

Fig. 2 I-V curve measured by simulator

- Introduction: Concentrating photovoltaic (CPV) technology used optical elements to focus sunlight on a tiny III-V solar cell. The concentrating ratio can be thousands times so the efficiency would be higher than traditional Si-modules. The world record efficiency of a full scale module is 38.9% made by Soitec. Besides, the world record efficiency (46%) of a III-V solar cell is still far from the theory limit (60%); therefore CPV has development potential.
- Development: The best efficiency in lab. of INER's CPV module is 35.15%, and the outdoor efficiency of a CPV module made by mass production technology is 32.7%. INER successfully reduced the thickness of CPV module, which focal length of the optical system is shorten from 20 cm to 6 cm. INER also utilized LED package techniques to CPV receiver to develop automatic process in order to improve yield ratio and decrease fund.
- Awards:

  2014 Taipei International Invention Show and Technomart , Silver Medal Award

  2016 Taipei International Invention Show and Technomart, Gold Medal Award

  2017 Taipei International Invention Show and Technomart, Bronze Medal Award