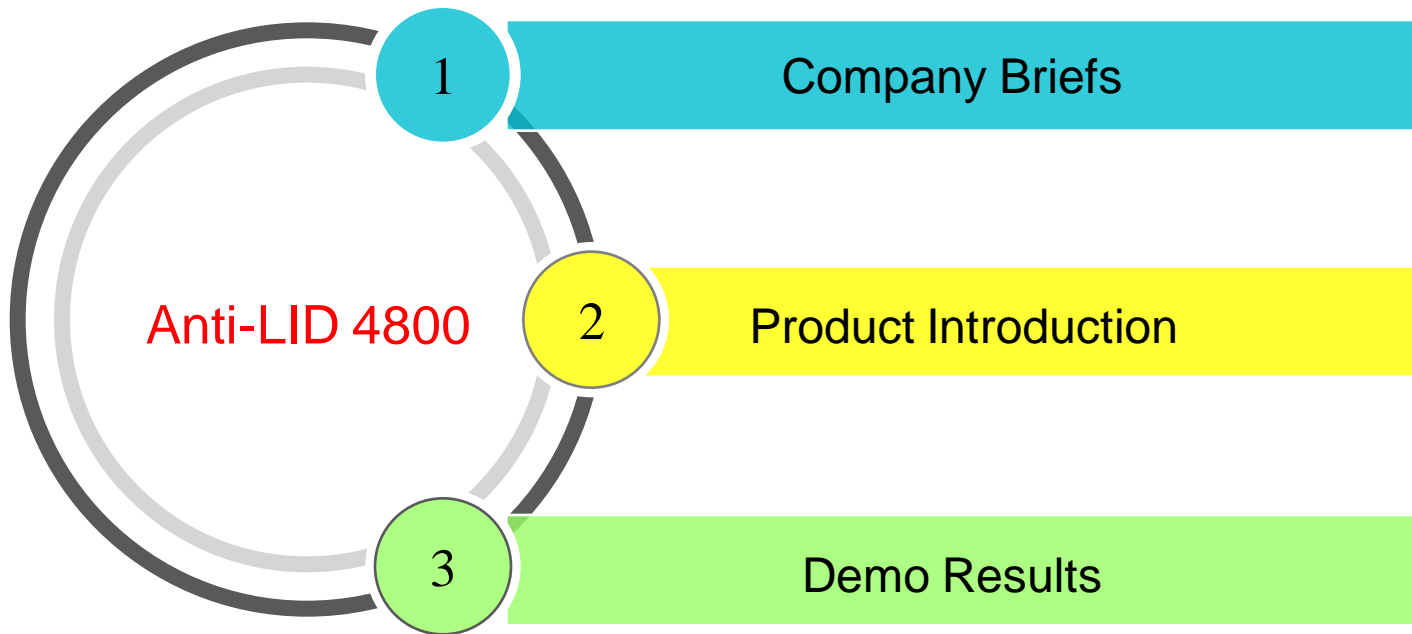


**Crystalline Silicon Solar Cell  
Bulk Defect Passivation Equipment**

**Anti-LID 4800**



# Agenda



# 1 Company Briefs

## Briefs

- Established by a Ph.D team from Silab, Zhejiang University
- Located in Liyang, Jiangsu
- Registered capital RMB 12.8 million
- Focused on R&D and manufacturing in c-Si wafer and solar cells

## Culture

- Philosophy: Innovate with times
- Core Values: Purity, Simplicity, Innovation, Sharing
- Mission: PV Wings



# 1 Company Briefs - Products

## Products

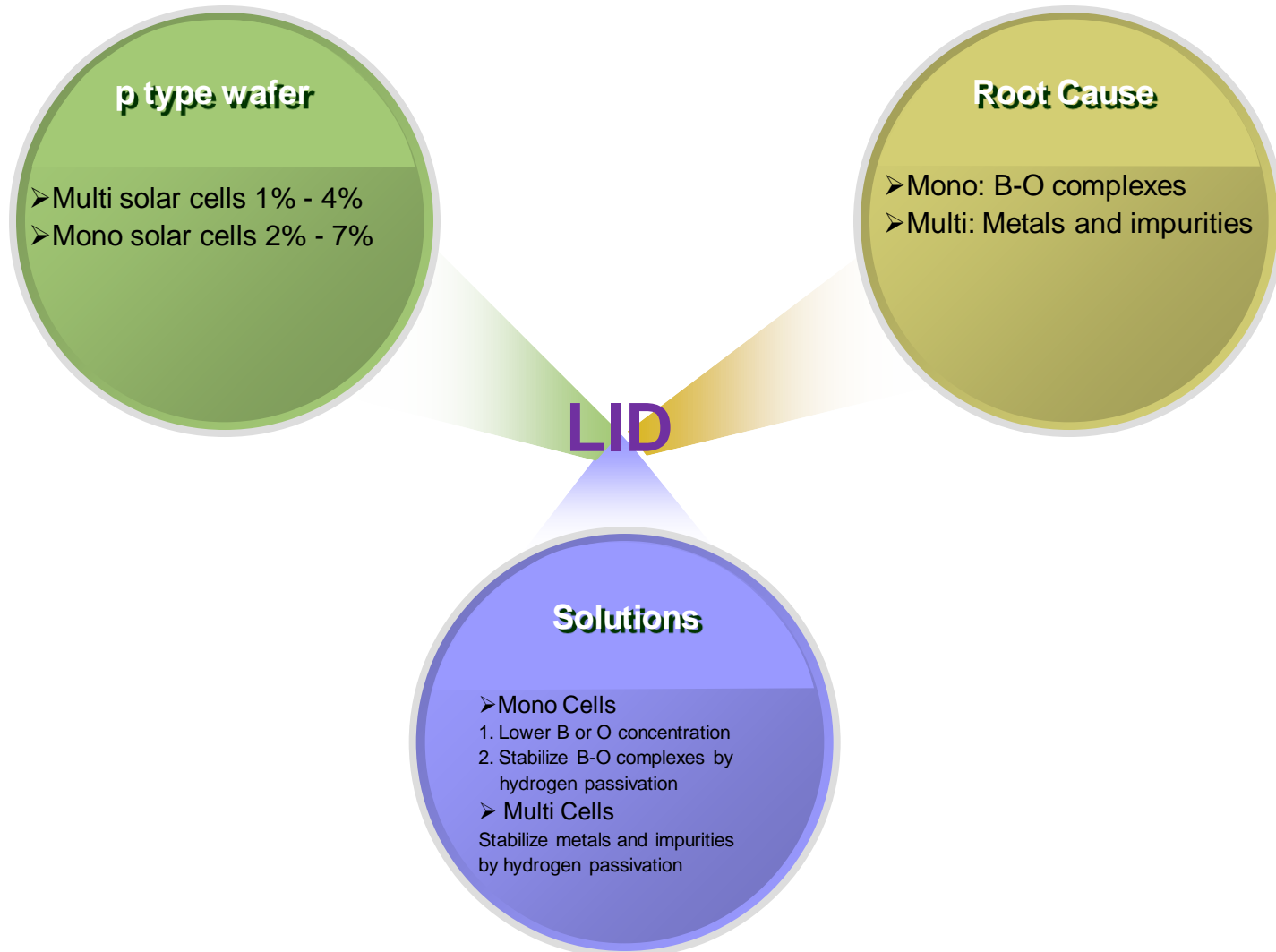


- Mono-Texturing Additive TS
- Multi-Texturing Additive TP
  - Polishing Additive PS
- Black Silicon-Texturing Additive BT10
  
- Anti-LID Equipment

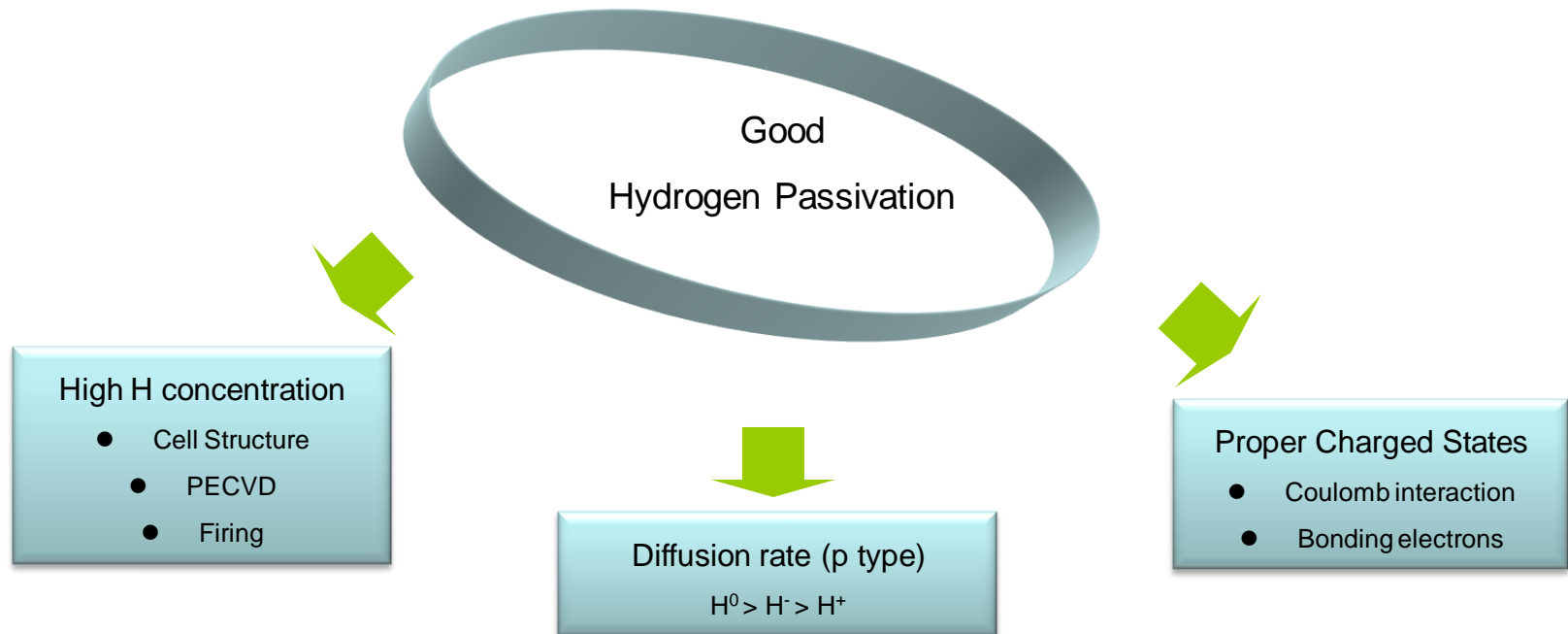
# 1 Company Briefs – Partners



Partners >21  
Sales Record > 39 sets  
New Orders > 33 sets



## 2 Product – Mechanism



Good hydrogen passivation needs high  $[H^0]$  and  $[H^-]$

## Hydrogen Passivation Solutions

### I. Heating

1. Fermi level up-shifted, higher  $[H^-]$  and  $[H^0]$
2. Faster diffusion rate of H
3. Passivated defects inclined to be activated

### II. Carriers Injection

1. Higher  $[H^-]$  and  $[H^0]$
2. Lower activation rate of passivated defects



#### Light injection:

→ solar cells radiated by high density LED or laser under certain temperature

#### Electricity injection:

→ solar cells powered by electricity under certain temperature

Song, L., et al. (2015). "Laser Enhanced Hydrogen Passivation of Silicon Wafers." *International Journal of Photoenergy* 2015: 13.

Hamer, P., et al. (2015). *physica status solidi (RRL) – Rapid Research Letters* 9(2): 111-114.

P.Hamer, B.Hallam, S.Wenham, and M. Abbott, *IEEE Journal of Photovoltaics*, vol. 4, no. 5, pp.1252–1260, 2014.

## 2 Product – Commercialization



Dual Lane Equipment



Scenergy  
Innovate with Times



浙江大学

ZHEJIANG UNIVERSITY

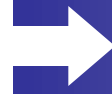
常州时创



**Mechanism:** Electricity injection

Mono cells: stabilize B-O complexes by hydrogen passivation

Multi cells: stabilize metal and impurities by hydrogen passivation



Type: single lane and dual lane

Mode: offline and inline

Pipeline position: between firing and sorting

## 2 Product – spec

### ▪ Dimension

- offline: 2610(L)\*1520(W)\*1920(H)
- inline: 4500(L)\*1520(W)\*1920(H)
- 1200KG (offline)

### ▪ Facility

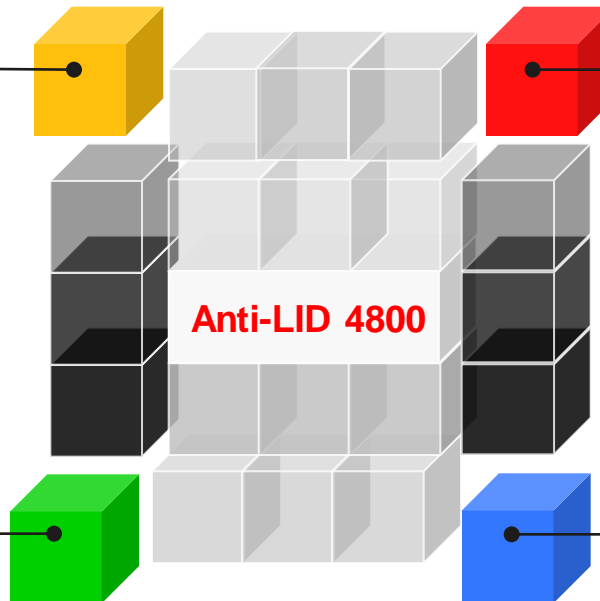
- Power: 380V TN-S, 35KW
- CDA: 0.5-1.0MPa, 100m<sup>3</sup>/h
- Thermal exhaust: 70-120Pa, φ160mm

### ▪ LID, η performance

- p type B-doped mono cell (Tube PE) <1%
- p type B-doped mono cell (Flat PE) <1.5%
- p type B-doped mono PERC cell (Tube PE) <1.5%
- p type B-doped mono PERC cell (Flat PE) <2.0%
- p type B-doped multi cell +0.03% - 0.05% absolute value
- p type B-doped multi PERC cell +0.15% absolute value
- p type B and Ga doped multi PERC cell +0.10% absolute value

### ▪ Throughput and Stability

- 10min 4800 pcs/h
- 15min 3200 pcs/h
- 20min 2400 pcs/h
- Uptime ≥ 98%
- Breakage ≤ 0.5‰



## 2 Product – Comparison

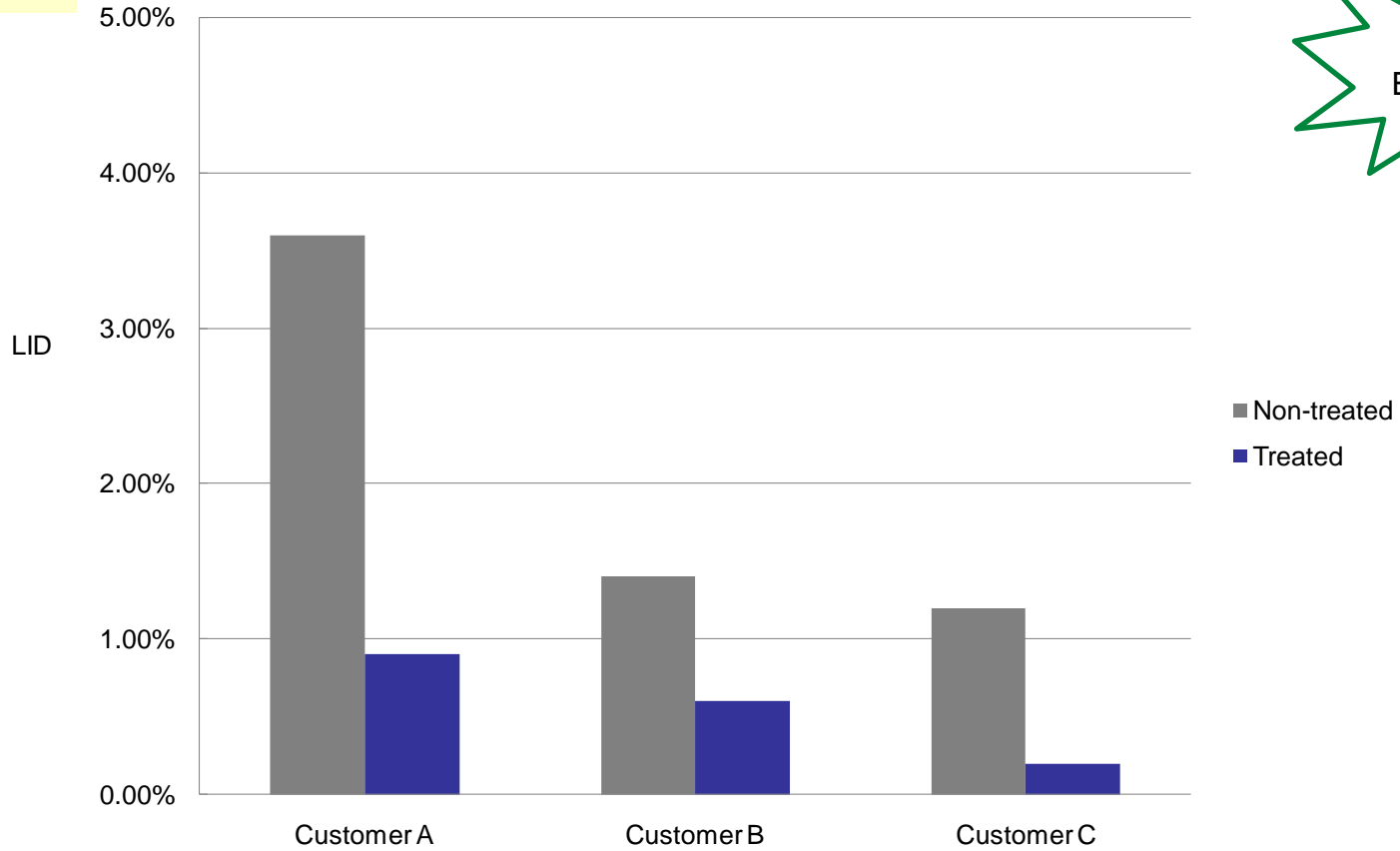
### Light injection (L) and Electricity injection (E) comparisons

<p><b>Cost of Ownership</b></p>	<ul style="list-style-type: none"> <li>L costs more electricity power, <math>\geq 1,539,839 \text{ KWh} / \text{year-set}^*</math></li> <li>Lamps of L cost RMB 84,000/year-set, while electricity power source is free of maintenance</li> <li>L needs cooling water, E needs no cooling water</li> </ul>	<p><math>\Delta \text{COO (L - E)}</math> <math>\geq \text{USD } 0.0015 / \text{Watt}</math></p>
<p><b>LID performance &amp; Efficiency Changes</b></p>	<ul style="list-style-type: none"> <li>Mono Cells               <ol style="list-style-type: none"> <li>LID performance: L and E, <math>&lt; 1.0\%</math></li> <li>Efficiency changes same or lower for L, same or higher for E</li> </ol> </li> <li>Multi Cells Efficiency same or lower for L, <math>+0.10\%</math> for E</li> </ul>	<p><b>Electricity Injection</b> Mono Cells: same or higher efficiency Multi Cells: <math>+0.10\%</math></p>
<p><b>Production Integration</b></p>	<ul style="list-style-type: none"> <li>L: Piece by piece inline</li> <li>E: in stacks</li> </ul>	<p>L – High integration E – Flexible integration</p>

\*L = 220KW , E = 35KW (offline)

# 3 Demo Results

Mono-BSF

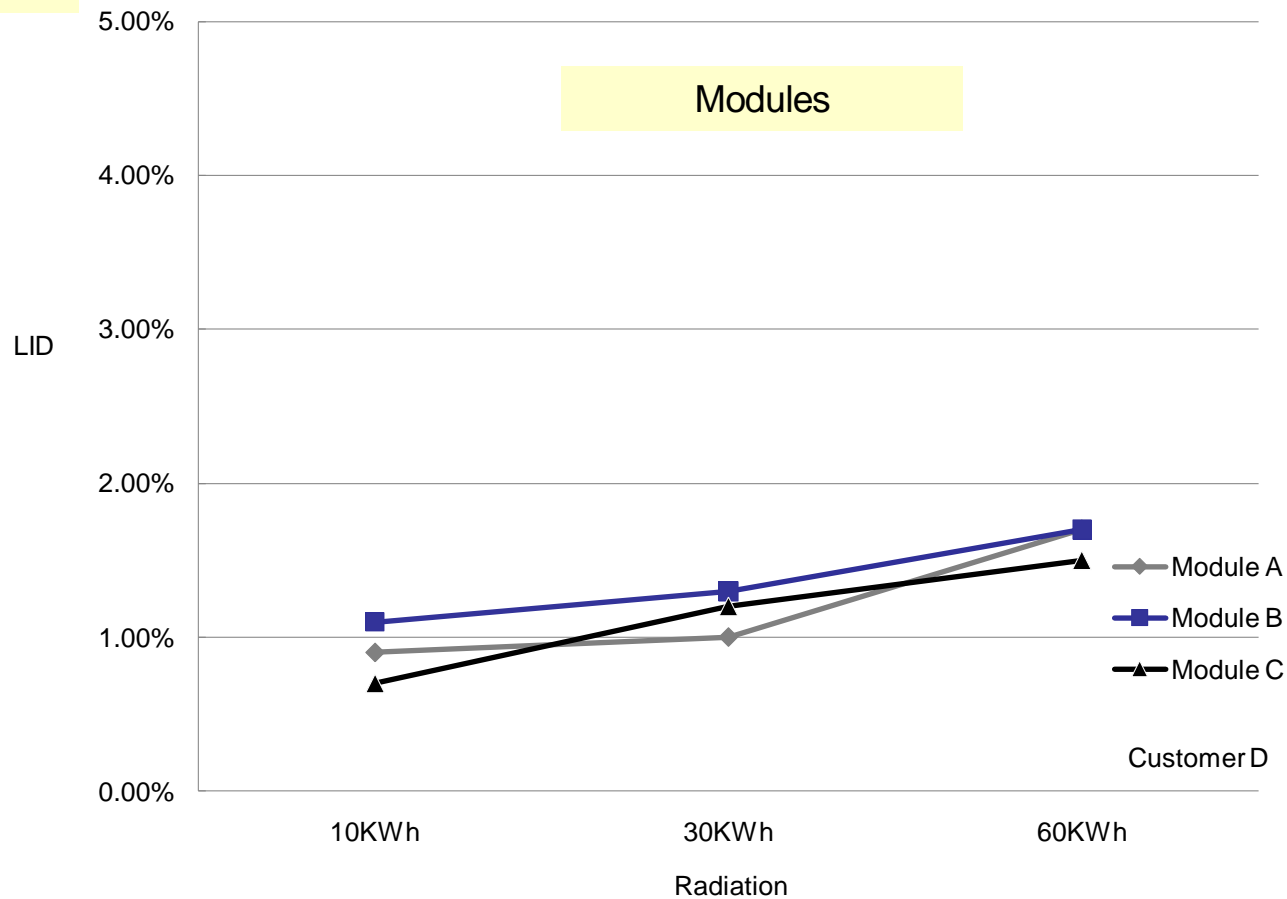


LID 1.0% for the Treated

LID criteria: 5KWh

# 3 Demo Results

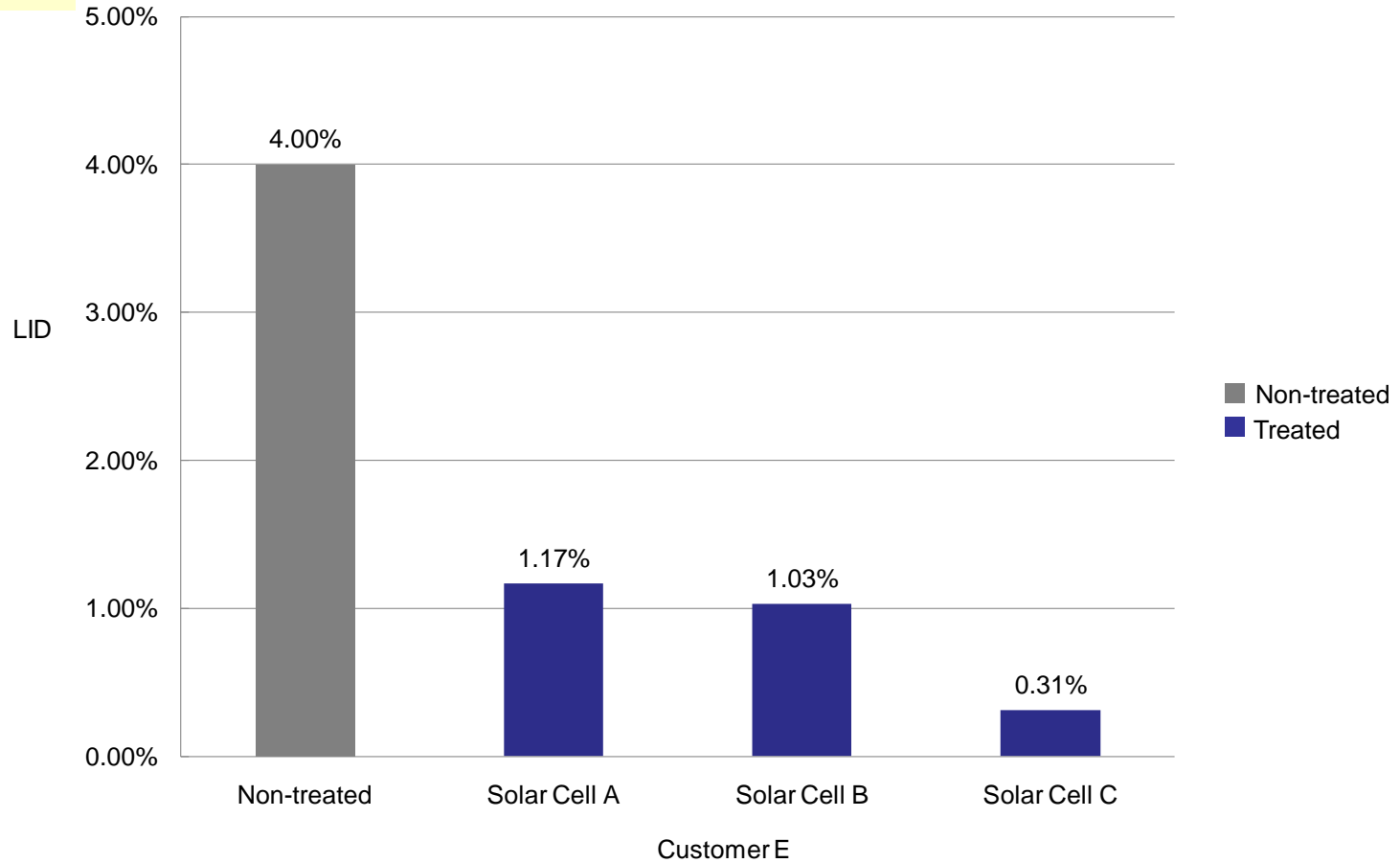
Mono-BSF



60KWh LID 1.5% - 1.7%

# 3 Demo Results

## Mono-PERC



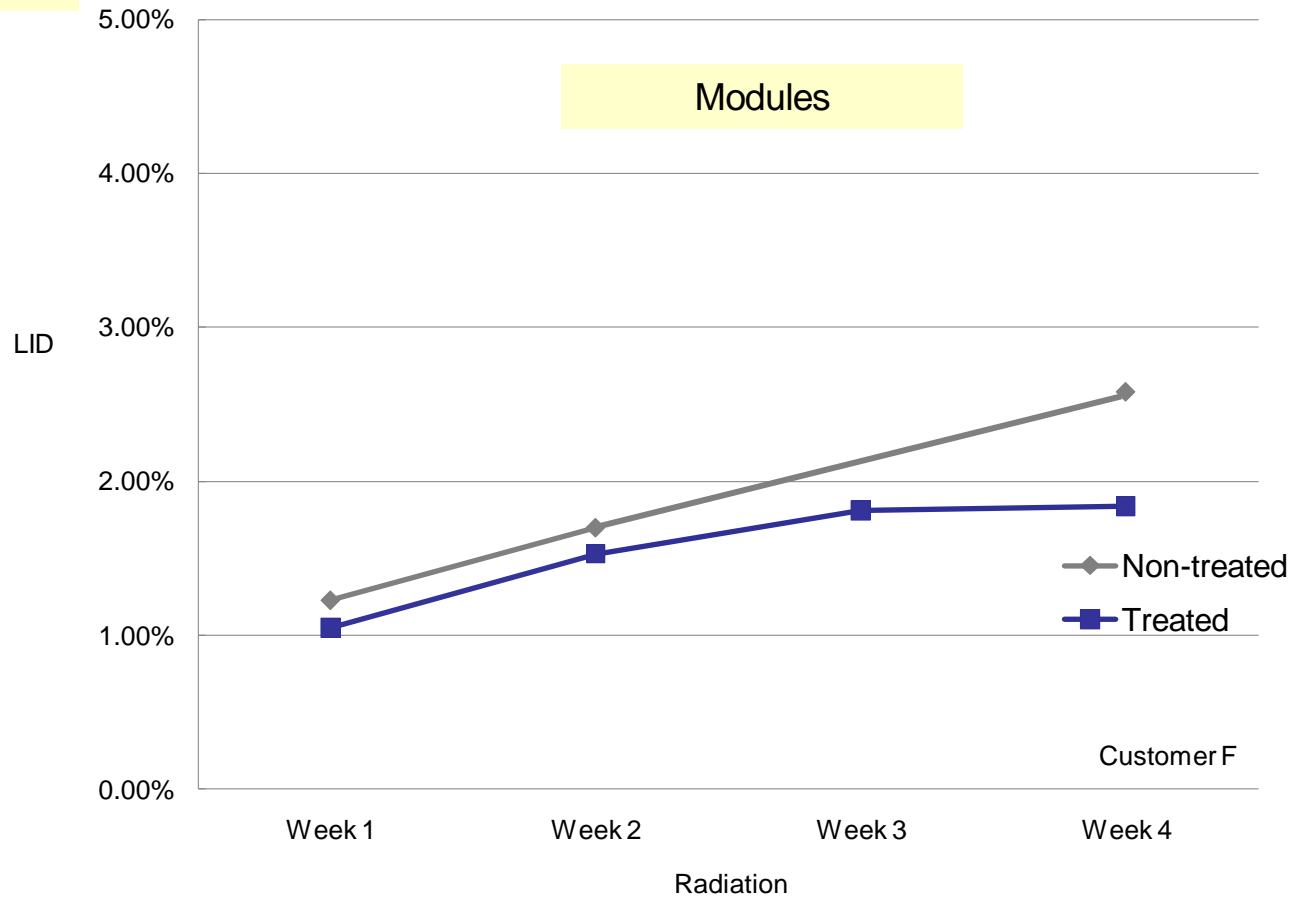
Mono-PERC cells with different wafer source

LID criteria: 5KWh

LID drops 2.83%~3.69% for the treated

# 3 Demo Results

Mono-PERC



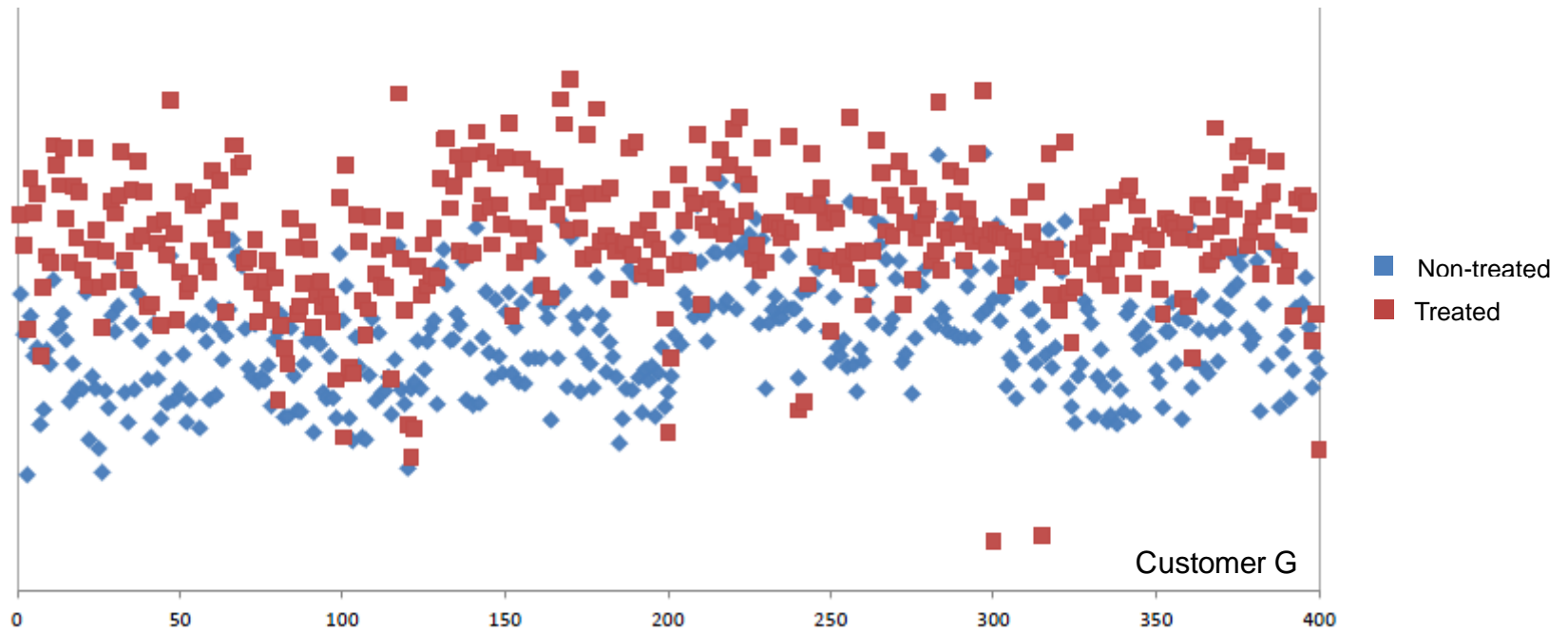
LID 2.58% for the non-treated

LID 1.84% for the treated

LID criteria: outdoor exposure

# 3 Demo Results

Multi-BSF

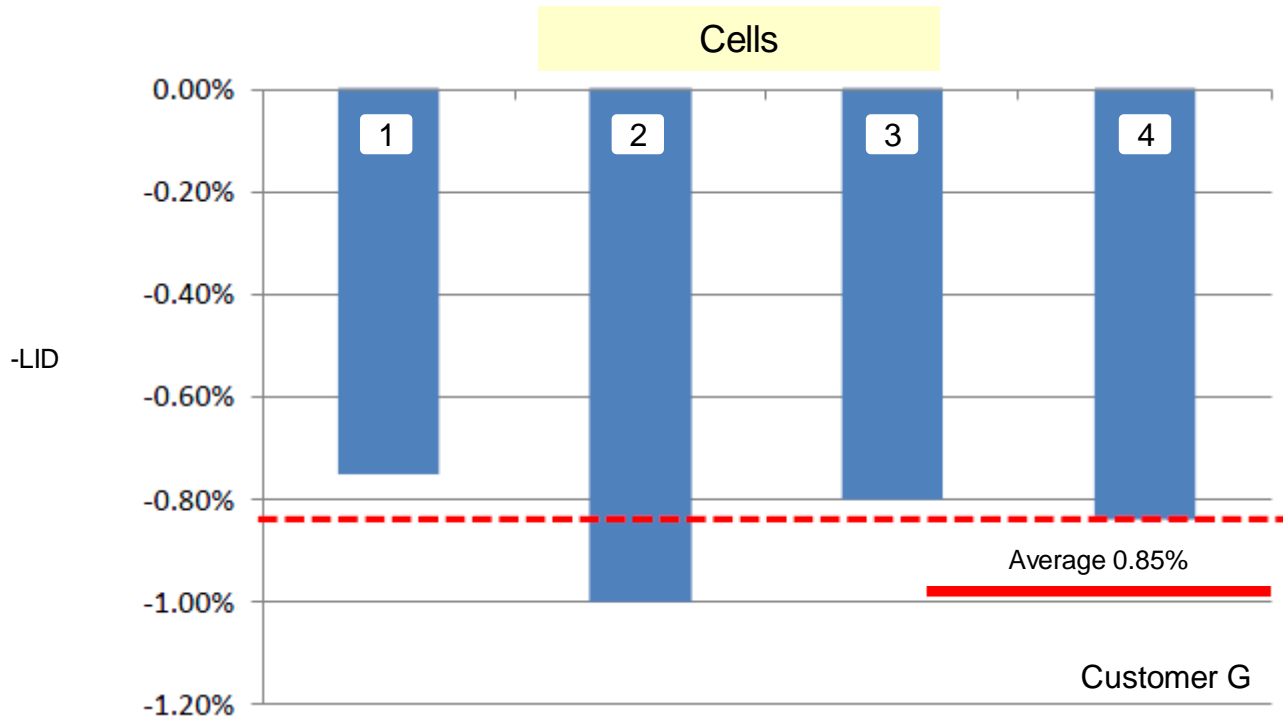


Efficiency change distribution for 400 pcs cells

Efficiency average gain 0.033%

# 3 Demo Results

Multi-BSF

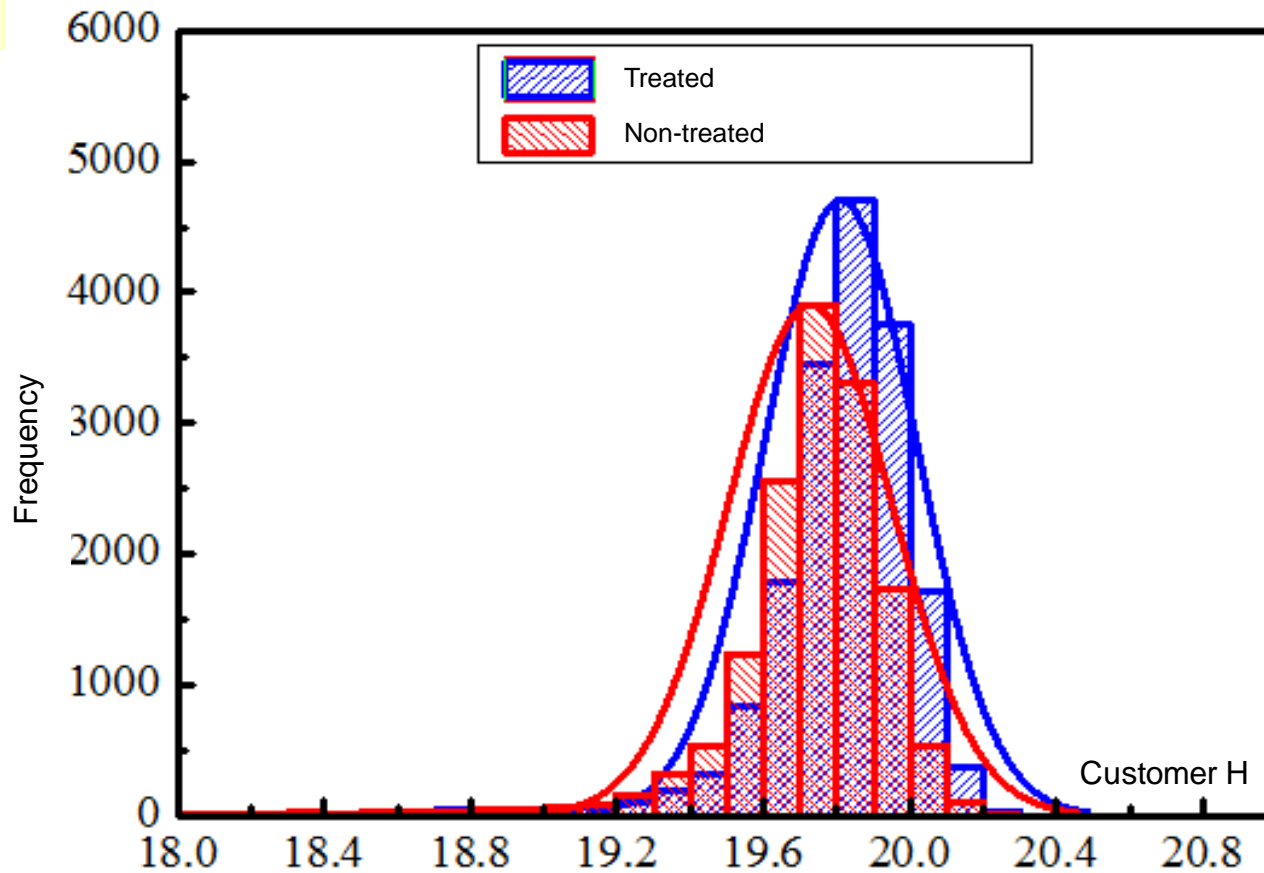


LID ratio distribution for 400 pcs cells in 4 groups

LID average value 0.85%

### 3 Demo Results

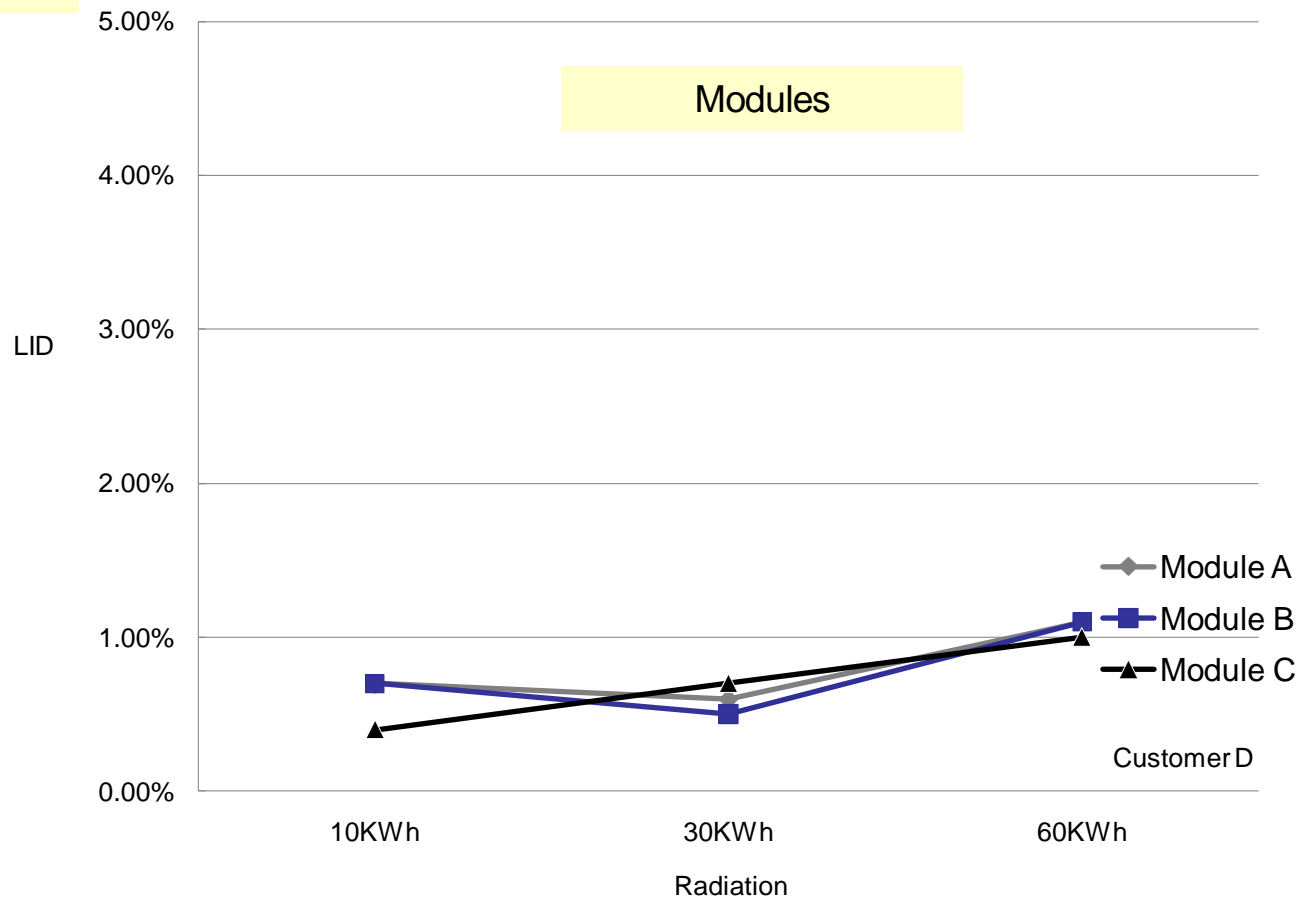
Multi-PERC



Efficiency average gain 0.10%

# 3 Demo Results

Multi-PERC



60KWh LID 1.0% - 1.1%

与时俱进 求是创新

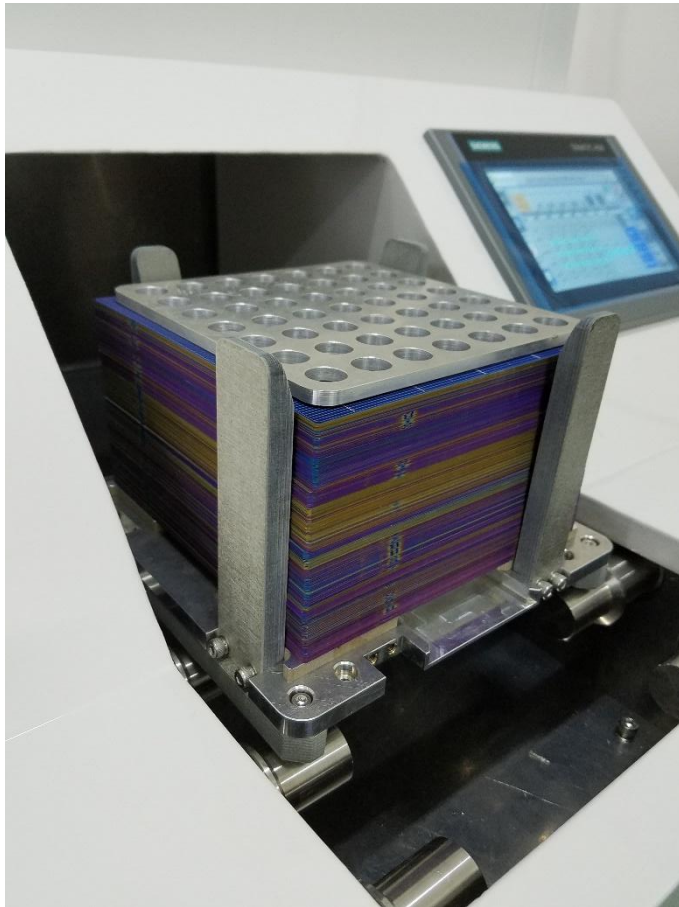


时创能源

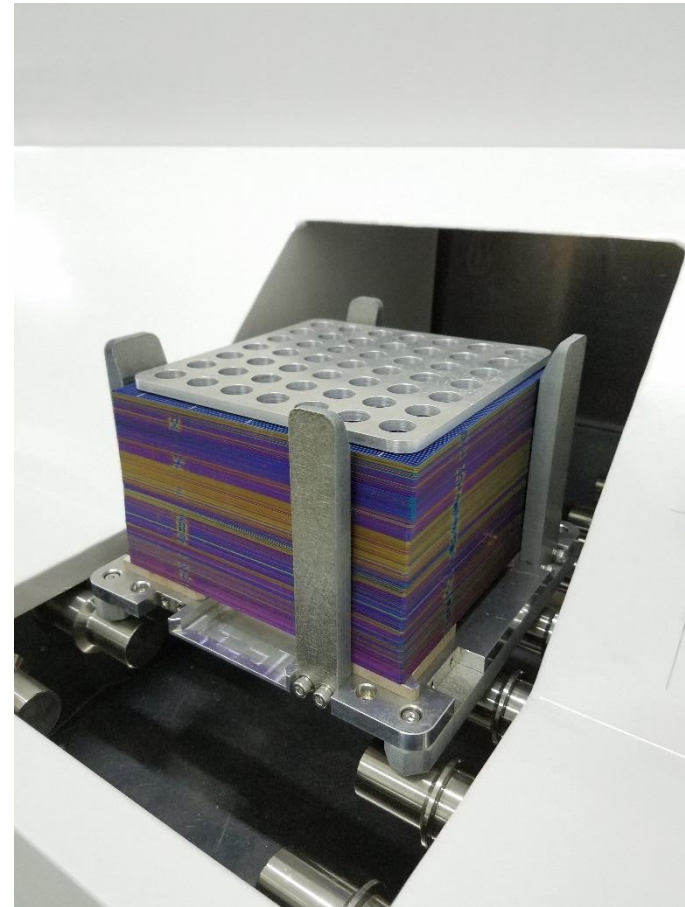
光伏翅膀

Thank you!

# Appendix - Cassette



Left view



Right view