

**Special session of Women in
Photovoltaics at PVSEC-27
Shiga, Japan**

Panasonic

Recent Progress of High Efficiency Silicon Heterojunction Solar Cells in Panasonic

**Toshie Kunii
Panasonic Corporation
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1. Self-introduction

2. Recent progress at Panasonic developing high efficiency silicon heterojunction (SHJ) solar cells

2.1 Features of HIT[®]

2.2 Structure of heterojunction solar cell

2.3 Approaches for higher efficiency

2.4 Progress in cell efficiency at Panasonic

2.5 Excellent performance even at high temperatures

2.6 Expansion of activities

2.7 Global production bases of solar business

3. Message



Toshie Kunii (PhD)

Technology Development Group, Solar Strategic Business Unit, Eco Solutions Company of Panasonic Group

- (1) Evaluation of tetrahedrally bonded amorphous and microcrystalline semiconductor films (Gifu University, 2000 ~ 2006)
- (2) Development of large-area deposition for the commercialization of silicon thin-film solar cells (R&D at Panasonic (Sanyo Electric Co., LTD), 2006 ~ 2010)
- (3) Development of manufacturing process for high efficiency silicon heterojunction (SHJ) solar cells (Solar Strategic Business Unit at Panasonic, 2010 ~ present)

I have worked on the development of various technologies related to silicon photovoltaic devices.

<My experiences>

Laboratory (small area process), mass production (large area process), thin-film solar cell (on glass), heterojunction solar cell (on c-Si wafer), cell technology, module technology



Panasonic's photovoltaic module composed of our original heterojunction type cells

Features



1. World's top level efficiency

- High efficiency cell (heterojunction structure)
- Original module technique

2. Excellent performance even at high temperatures

- Good temperature co-efficient of η
-0.29%/°C in mass-pro. module

3. High reliability

- Module structure/material customized for heterojunction cells
- Environmental test severer than industry standard
- PID resistant

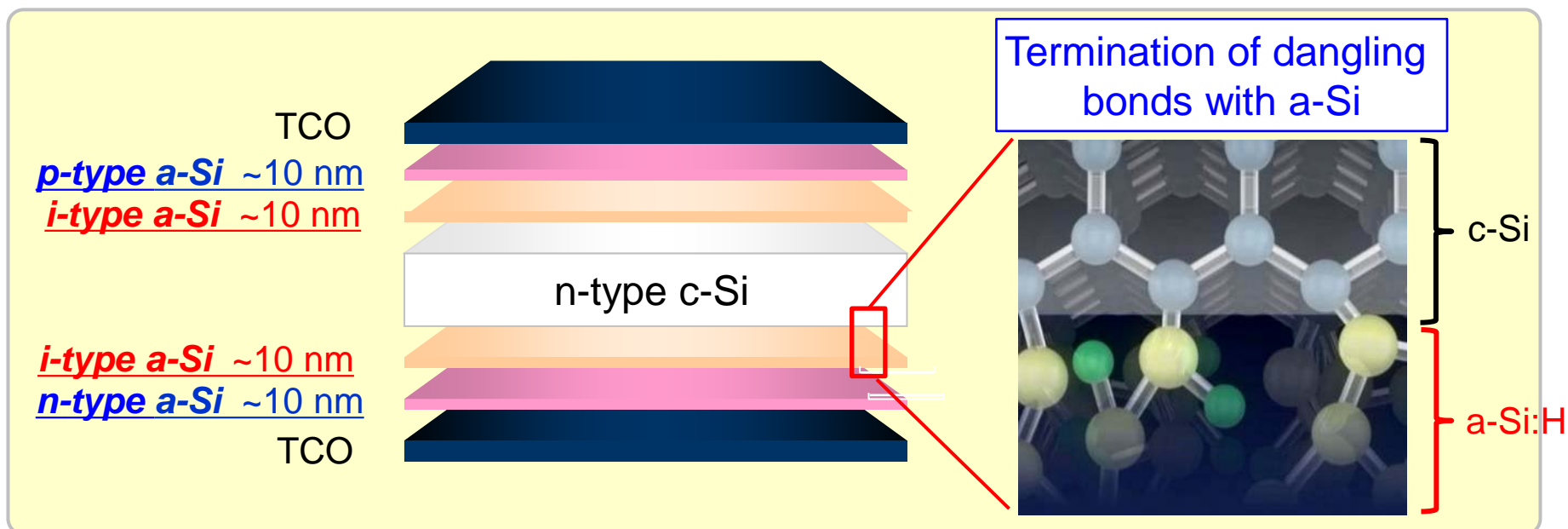
4. High-value module applications

- Bifacial power generation
- Modules suited to various roofs

Good passivation with semi-conductive film; “a-Si:H”

Formation of p-n junction, BSF using “i/doped a-Si:H”

- Heterojunction acts as barrier to block the holes at backside
- Doped a-Si:H/TCO multi-layer forms good ohmic contacts



TCO (Transparent Conductive Oxide)

1. Optical confinement to enhance I_{sc}
2. Advanced passivation technique to enhance V_{oc}
3. Lower resistance to enhance FF

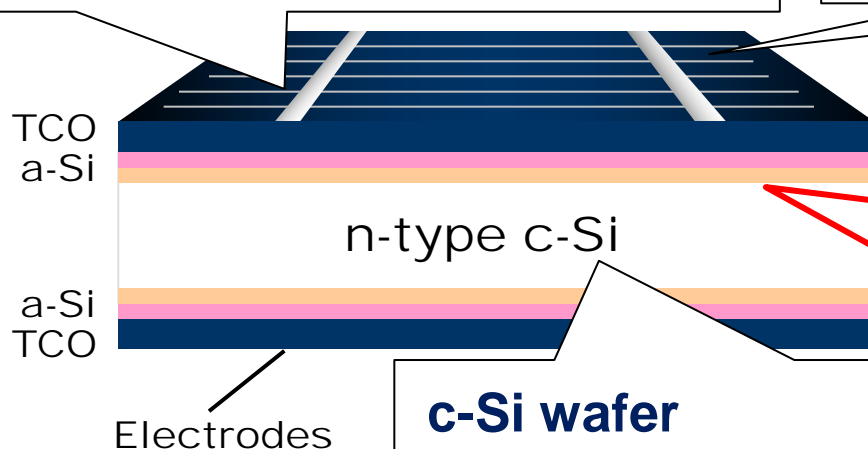
Metal electrodes

- Fine & high aspect
- Low resistance
- Optimized pitch



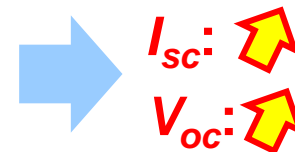
TCO layers

- Low absorption
- High conductivity



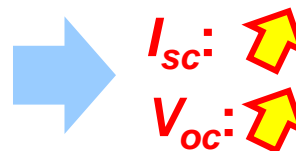
a-Si layers

- Low absorption
- High passivation



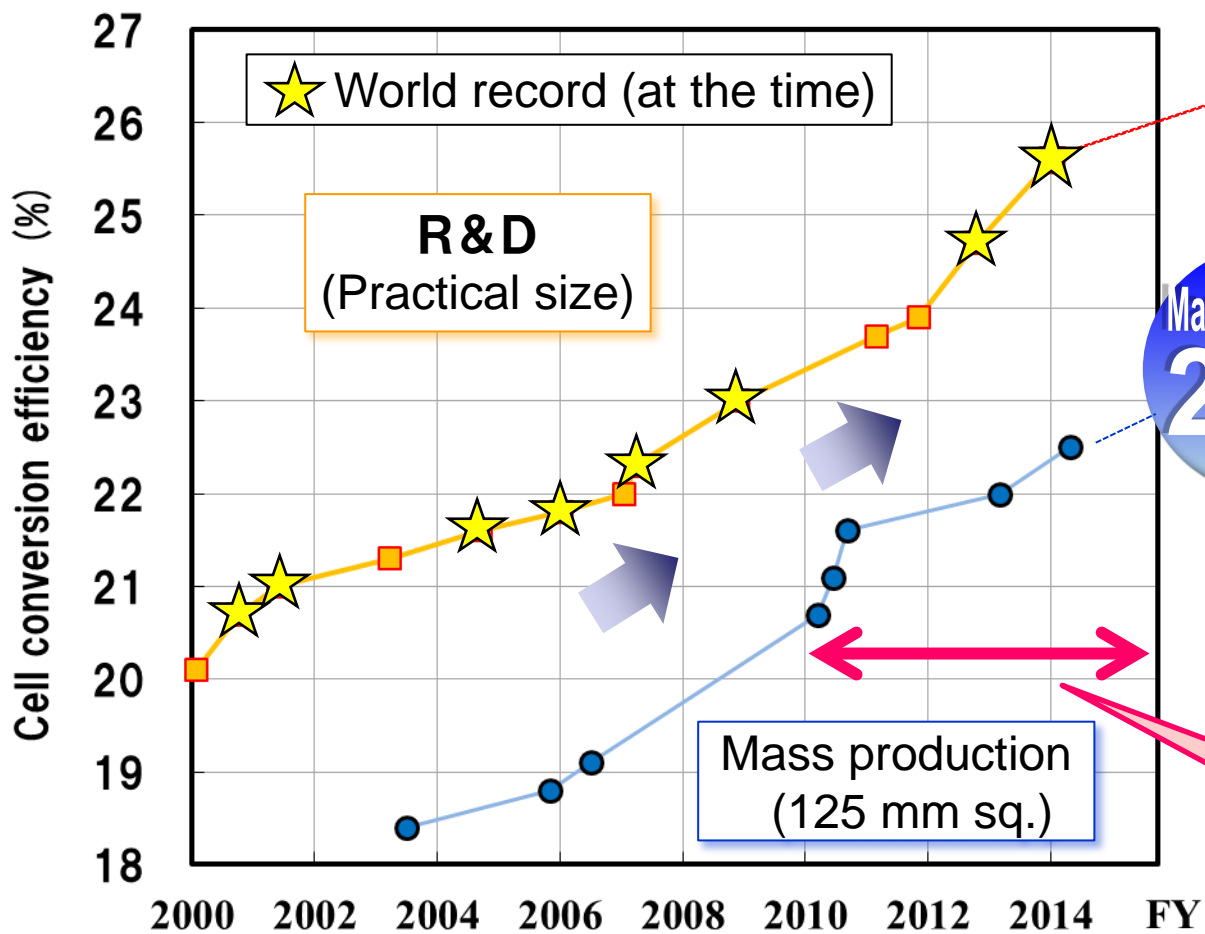
c-Si wafer

- Optimized bulk character
- Fine texture
- Ultra-clean surface



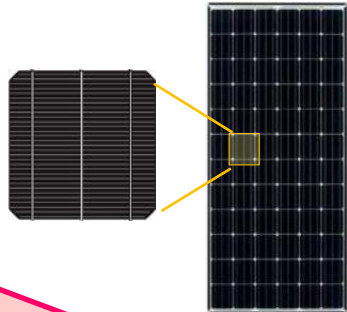
My main work

Our heterojunction cells have always had the highest efficiency in crystalline silicon solar cells



R&D
25.6%

Mass Production
22.5%



I joined
Solar Business Unit

Excellent performance even at high temperatures

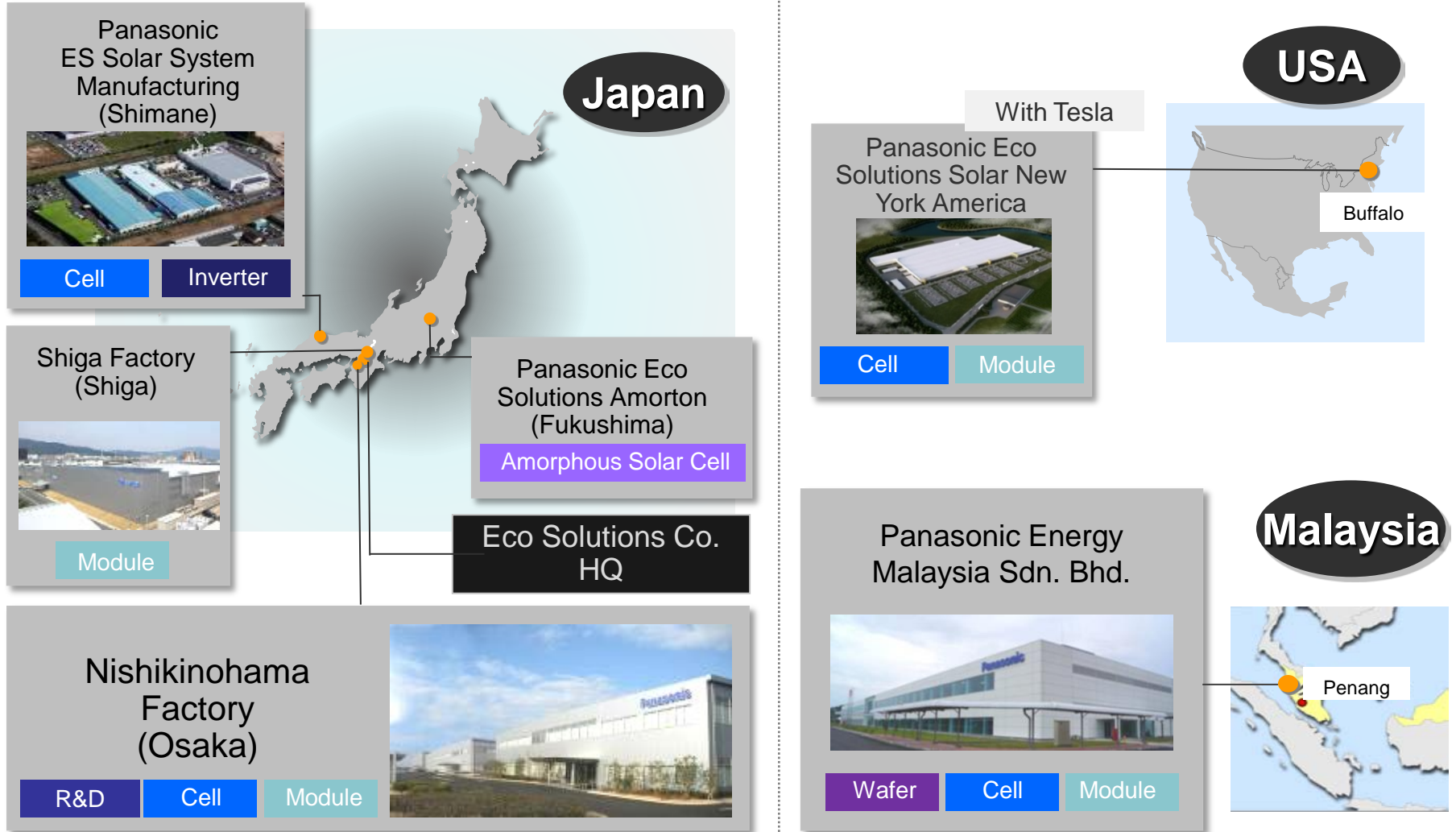
HIT[®] can maximize annual amount of power generation by its high conversion efficiency and excellent temperature coefficient



Calculation condition of the annual energy production , area: Osaka city, orientation: south, incline: 30° (referred by Industrial self imposed rule about marking(JPEA 2014)). The above numbers are simulated value)

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Challenge yourself to pursue what you want to do!

There is **no** technology development that limited by gender.

Devote yourself to the task in front of you!

All of my past experiences are helpful for me in my latest work.

**We will continue to advance in our careers
and deliver pleasing products to the world!**

Panasonic
Homes & Living