

1. Background

Reliability of PV module becomes important increasingly as PV modules are expected to operate for more than 25 years, compared with previous market of 20 to 30 years ago. Especially, as PV modules are installed outside and are subjected to external forces from wind, snow and daily/seasonal temperature cycle, cell strength is one of the key points to maintain PV module output for a long term. Mitsubishi Electric has introduced PV modules using 4 bus bar cells in 2010, and is shifting to manufacturing them from previously standard two bus bar cells to improve reliability of PV modules in addition to increase of cell efficiency by 3%.

2. Advantage of Four bus bar cell

1) Reduction of residual stress peaks

Four bus bar cells use finer interconnectors and front electrodes which have 1 mm width than two bus bar cells whose interconnectors and front electrodes have 2 mm width to maintain same light receiving area as two bus bar cells. Using finer interconnector and electrode can reduce residual stress peaks along interconnectors which occur when interconnectors are soldered on the electrodes. Figure 2 shows the simulation result of residual stress peaks of a four bus bar cell and a two bus bar cell after assembling interconnectors on a cell. The stress peaks of the four bus bar cell along interconnectors are approximately 3/4 of the two bus bar cell peaks. The decrease makes PV modules more robust to external forces and can keep more output. In addition, the yields of four bus bar cells also improve and material waste can be reduced during manufacturing.

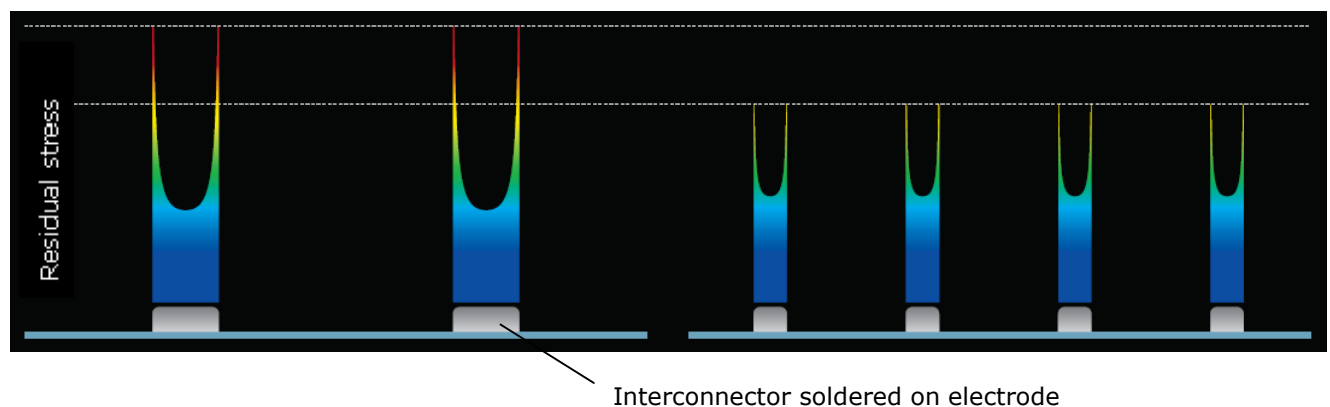


Fig. 2 Stress distribution of two bus bar cell (left) and four bus bar cell (right)

2) Robustness of output

Four bus bar cells can reduce power loss compared with two bus bar cells, in case that cell breakage occurs by unexpected force,. Figure 2 shows that current path of the four bus bar cell is shorter than the two bus bar cell's one under cell breakage occurrence. As the current path is shorter, then the four bus bar cell can reduce output loss compared with the two bus bar cell.

3. Technologies to use four bus bar cell

As described above, the four bus bar cells need to have finer interconnectors and electrodes. Therefore it is necessary to align and solder them precisely. Mitsubishi Electric has introduced the new alignment system employing the image processing unit and achieved +/- 0.1 mm accuracy. In addition, the introduced system inspects alignment accuracy between the electrodes and the interconnectors and it prevents cells with deviation errors from passing through to next process.

4. Conclusion

Four bus bar cells have achieved:

- 1) **More robustness to external forces reducing residual stress peaks**
- 2) **More reliability against unexpected cell breakage.**

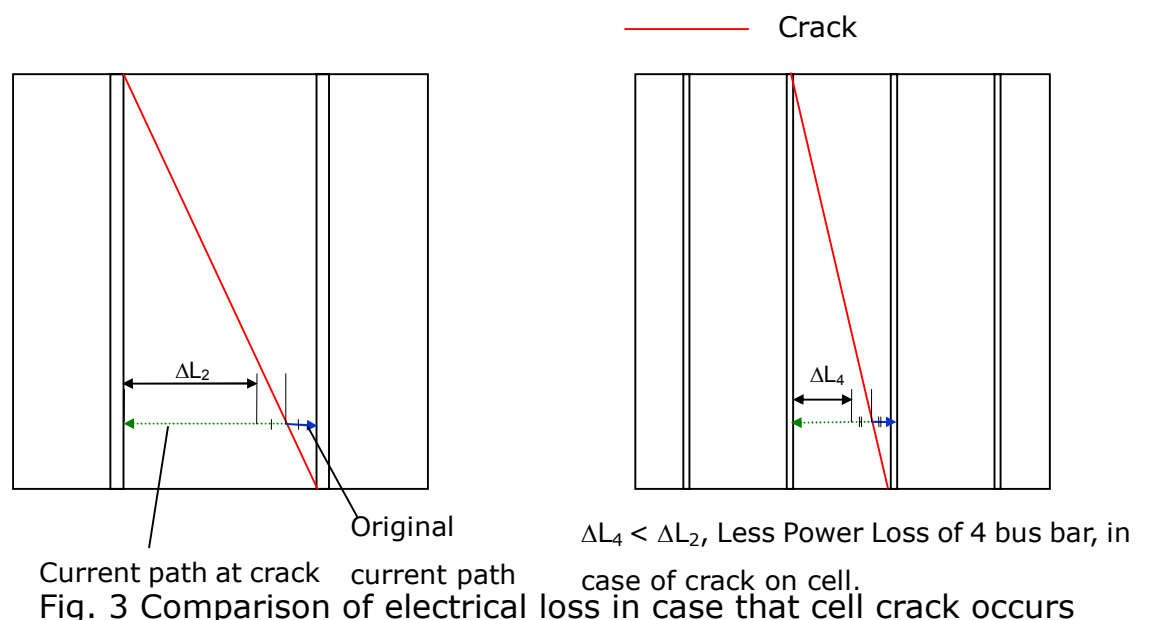


Fig. 3 Comparison of electrical loss in case that cell crack occurs

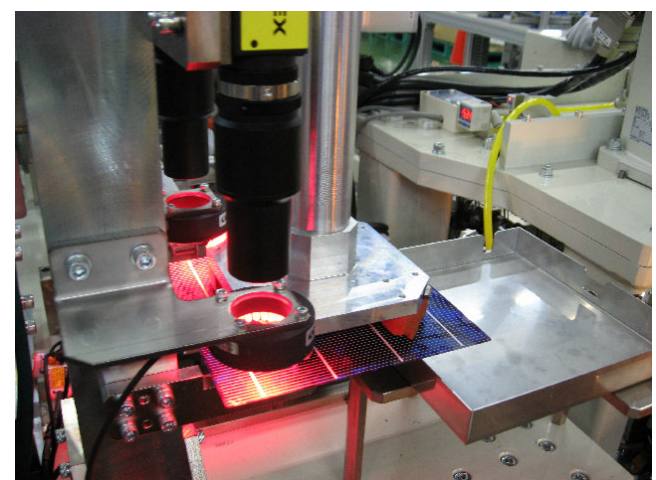


Fig.4 The new alignment system employing the image processing unit.