ALSOLAR® for PERC solar battery

Moeko Matsubara
Research & Development Dept. ,
Core Technology Center,
Toyo Aluminium K.K.

Crystalline silicon solar cell

【 1. Introduction 】

Our ALSOLAR is used in crystalline silicon solar batteries as back electrodes (see ALSOLAR, Technical Report - Winter 2012). Crystalline silicon solar batteries are the mainstream of solar batteries currently produced and further reductions in cost and improved efficiency are required. Studies to increase efficiency have been conducted across a wide area. One that is attracting attention now for mass production is the rear passivation (PERC: Passivated Emitter and Rear Cell) solar battery. The PERC solar battery is intended to reduce energy losses induced by recombination at the interface between the silicon on the back surfaces of current solar cells and alminium electrodes by inducing a passivation film (SiN, SiO_2, Al_2O_3, etc.) to enhance efficiency (see Figs. 1 and 2).

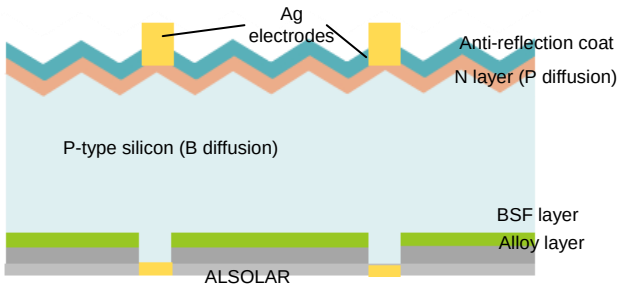

Fig. 1; Structure of current solar cell

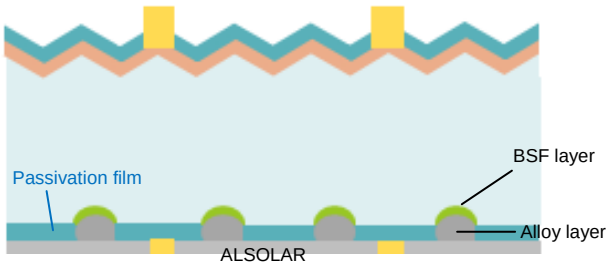

Fig. 2; Structure of PERC solar cell

【 2. Structure of PERC solar battery 】

The difference between a PERC solar cell and the current one is that the former has a passivation film introduced on the back surface. Because the passivation film is an insulating material, if it covers the entire back surface, contact cannot be established. To have contact, the silicon and alminium electrodes need to make contact at certain places. Several methods for forming such contact points between alminium and silicon have been studied on a mass-production line. This report provides an explanation on two of them as follows.

1. Perforation type
2. Fire through type

1. Perforation type

After forming the passivation film on the entire back surface of the cell, the passivation film at part of the point contacts is removed using a laser or an etching paste, followed by application of an alminium paste and subsequent firing. (Left side of Fig. 3)

2. Fire through type

After forming the passivation film on the entire back surface of the cell, an alminium paste for Fire through is applied at parts of the point contacts. When firing the cell, contact can be established by penetrating (firing through) the film through a reaction between alminium paste and film (Right side of Fig. 3).

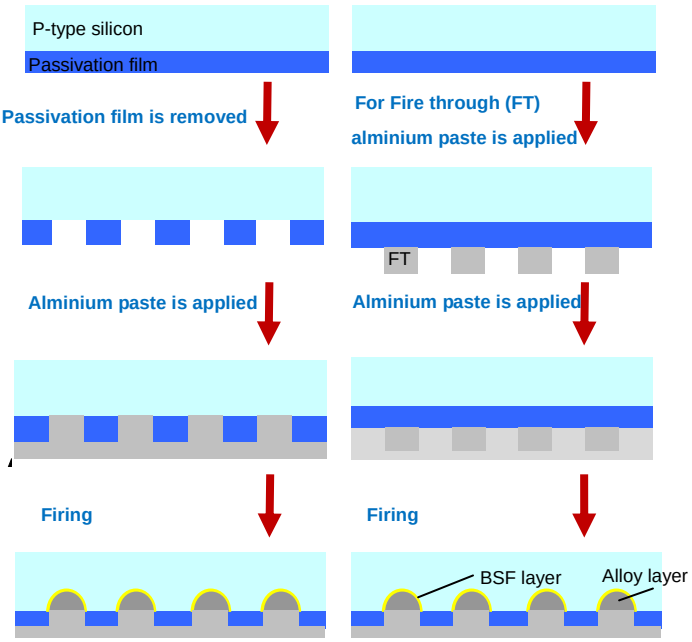

Fig. 3; Back surface of solar cell
(Left) Perforation type (Right) Fire through type

【 3. Challenges with alminium paste for PERC 】

We are developing ALSOLAR for both perforation type and Fire through type. The challenges differ from the standard ALSOLAR.

The two major challenges with the perforation type ALSOLAR are as follows.

Task 1) Cavity at point contacts

Unlike existing solar cells, the perforation type involves a local reaction between silicon and alminium at contact points. If the standard ALSOLAR is used here, alminium takes part in the reaction with silicon excessively, resulting in a cavity without forming an alloy layer and BSF (Fig.4). Therefore, ALSOLAR is required to be designed to control the reactivity of alminium, in order to obtain a homogeneous alloy layer and BSF (Fig.5).

Task 2) Adhesion to passivation film

Most alminium electrodes, as distinct from current solar cells, make contact with a passivation film. It is important to improve the adhesion of ALSOLAR without damaging the passivation film.

On the other hand, the performance required for ALSOLAR for Fire through induces a reaction with the passivation film during a firing process to penetrate the film and form an alloy layer and BSF, and then providing contact. Although the performance of Fire through can be improved with a higher firing temperature, firing at high temperatures causes crystal defects in cells, leading to lower efficiency. Therefore, how to achieve Fire through under normal firing conditions is a challenge to ensure uniformity of alloy layer and BSF.

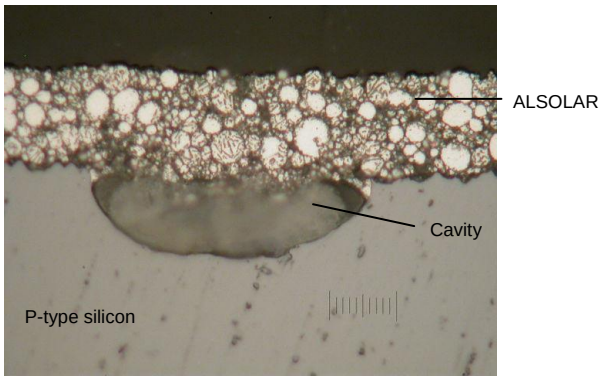

Fig. 4; Standard ALSOLAR used

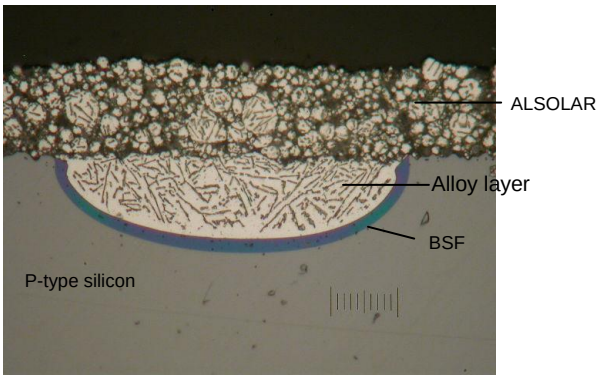

Fig. 5; Perforation type used

【 4. Closing 】

At present, as products for our next-generation solar cells, we are working with customers on samples of ALSOLAR primarily for the two types described above to solve the challenges and have them adopted. As the structure of solar cells evolves, the requirements for ALSOLAR will change. We will continue to follow trends in the structure of solar batteries and develop them to supply alminium pastes that meet users' needs.