Selective boron emitter formed by chemical etch-back process for n-type bifacial solar cell

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The bifacial solar cell concept is a promising way to produce more electric power with low production cost, because it increases the performance of a photovoltaic system by taking advantage of its bifaciality, which is the ratio of the rear and front side efficiencies. In our previous research result, an n-type bifacial solar cell with an efficiency of over 20% was presented, and PC1D simulation was performed based on our baseline cell. According to the simulation, two main aspects are required to increase the cell efficiency over 22%, they are: (1) developing a selective boron emitter structure, (2) Decrease the rear side phosphorus doping concentration. In our previous research, we also discussed a successful etch-back process for boron emitter, and the various etched-back boron emitters evaluated by measuring J_{0e} on symmetrical p^+np^+ structure with SiN_x/Al_2O_3 passivation stack. Very low J_{0e} of 23, 15 fA/cm^2 were obtained for the 100, 160 Ω/□ etched-back emitters, respectively. An improvement in the open-circuit voltage with low J_{0e} is expected [1].

Within this study, we will discuss a fabrication of selective boron emitter n-type bifacial solar cell (as shown in figure 1) in which the boron emitter was formed by BBr_3 thermal diffusion and the boron selective emitter (p^+/p^{++}) was formed by etch-back process and by a screen-printed resist masking technology.

Boron selective emitter n-type bifacial solar cells were fabricated on Cz wafers (156×156 mm^2 n-type 200 μm thickness pseudo-square) with resistivity around 2.2 Ω cm. After the initial boron diffusion, a resist mask was screen-printed. Next, the Si wafers were immersed in to the solution to etch-back process for boron emitter, followed by resist mask removal. The initial boron sheet resistance (49 Ω/□) of p^{++} region was increased to 140 Ω/□ for the etched-back p^+ region. The p^{++} region resist mask is 240 μm wide. The next step involves the RCA cleaning, SiN_x/Al_2O_3 was deposed on the front p^{++} and p^+ region as a passivation layer and antireflection coating. Then, Al/Ag gridlines were aligned and screen-printed on p^{++} region, followed by the firing in an industrial-style belt furnace.

The details of the cell fabrication process and the I-V characteristics of the cell including the analysis will be presented in the conference.

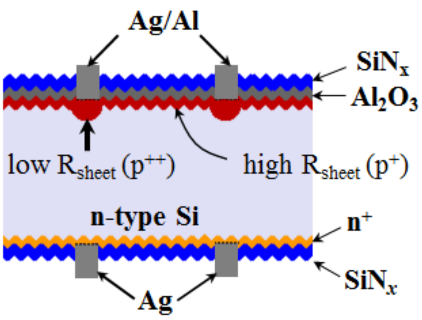

Figure 1: The cross section of selective boron emitter bifacial solar cell.

References

[1] Shalamujiang Simayi, Yasuhiro Kida, Katsuhiko Shirasawa, and Hidetaka Takato, "Recombination analysis of etch-back boron emitter for n-type bifacial solar cell", 64th JSAP Spring Meeting, 2017.