

Phosphorus Gettering of Impurities for p-type PERC solar cells

°S. Joonwichien, Y. Kida, M. Moriya, S. Utsunomiya, K. Shirasawa, and H. Takato

E-mail: s-joonwichien@aist.go.jp

This paper shows a room for improving the performance of p-type passivated emitter and rear cells (PERCs) using the method of phosphorus (P) gettering of impurities at low-temperature annealing. Optimal low temperature annealing was pursued to control the segregation process of impurities during P-gettering, including the crystal defects formation. After P diffusion process, gettering process was done at 400°C with different annealing times under N₂ ambient, followed by a subsequent removal of rear-side of gettered P-diffused layer of the wafer, surface passivation deposition, and so on [1].

As a result, a significant positive P gettering effect was found, as can be seen by an increase in lifetime with the gettering time increased (Fig. 1a). The results for the measured *I-V* parameters of the 2 h gettered PERCs revealed an increase in the open-circuit voltage (V_{oc}) and short-circuit current density (J_{sc}) values with an increase in the gettering time, and the change in the fill factor (*FF*) was negligible (Fig. 1b). The internal quantum efficiency (IQE) of the 2 h gettered PERC shows a notable improvement for both short- and long-wavelength photons, indicating better quality of Si bulk as well as the surface passivation. A possible reason can be explained by the increased collection of dissolved impurities at P-gettered layers during low-temperature annealing. This low-temperature annealing should provide sufficient thermal energy for fast diffusing impurities in the bulk releasing towards P-diffused layer (external gettering). The slow diffusing impurities can internally gettering at the defects and/or nearby precipitates, leading to the reduction in the recombination activity per atom. These results further confirmed the benefit of P gettering at low-temperature annealing in order to improve the electrical properties and yield of PERC solar cells.

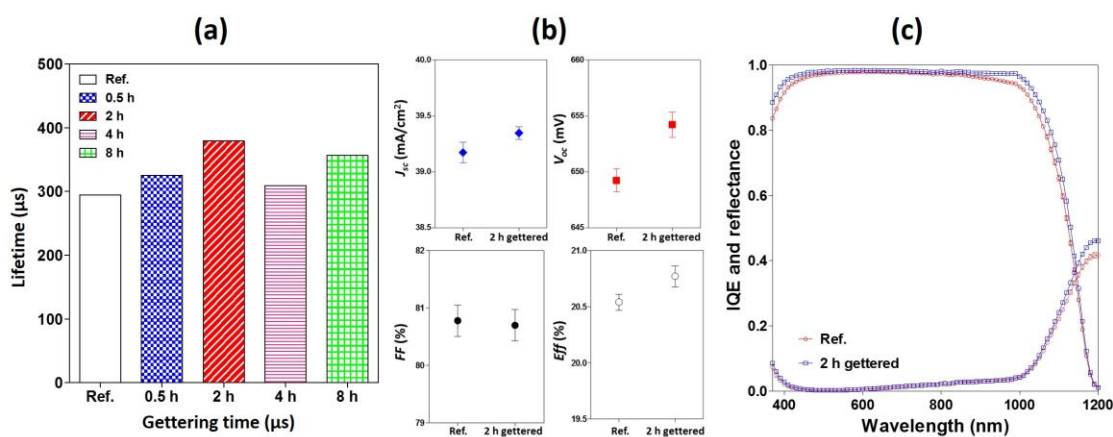


Fig. 1 (a) lifetime of symmetrical samples (Si/AlO_x/SiN_y) with different gettering times. (b) *I-V* parameters of 2 h gettered PERCs. (c) Measured IQEs and R curves of 2 h gettered PERCs.

[1] S. Joonwichien, S. Utsunomiya, Y. Kida, M. Moriya, K. Shirasawa, and H. Takato, *IEEE J. Photovol.* 8 (2018) 54-58.