In this study, the effects of annealing on passivation quality of poly-Si/SiOx/c-Si contact (poly-Si contact) were investigated. For experiments, intrinsic poly-Si layers were deposited by LPCVD on a tunnel oxide surface, followed by n+ poly-Si doping via diffusion in a POCl3 tube furnace. For lightly doped poly-Si contacts, higher temperatures and longer times increased $V_{OC}$ achieving maximum value of 734 mV, because of a poly-Si grain growth effect, as shown in Fig. 1. However, for highly doped poly-Si contacts, $V_{OC}$ decreased from 731 mV to 696 mV as annealing time increased, which was caused by Auger recombination. The effects of poly-Si grain growth and Auger recombination on passivation quality of poly-Si contacts were analyzed in detail. Finally, a TOPCon solar cell using a poly-Si contact on the back and boron diffused emitter on the front was fabricated. As a result, a solar cell with 21.1% efficiency, 665 mV $V_{OC}$, 40.6 mA/cm$^2$ $J_{SC}$, and 78.3% fill factor was fabricated as shown in Fig. 2.

Figure 1: Implied open circuit voltage of poly-Si contacts as a function of annealing temperature for 10 min and annealing time at 950 °C

Figure 2: I-V curve result of solar cell fabricated using poly-Si contacts structure