Influence of laser damage and contact geometry on the performance of passivated emitter and rear cell solar cells

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Abstract:

The characteristics of laser ablation prepared on the structures of a passivated emitter and rear cell (PERC) using additional laser irradiation were investigated. Particular emphasis was placed on the distribution of laser damage and contact geometry on the cell performance. The residual Al_2O_3 passivation layer of the Al_2O_3/SiN_x passivated samples was removed almost completely by three laser shots. No severe damage profile was observed near the silicon surface, but damage profiles with a thickness of 10-15 nm were observed in the form of amorphous silicon. Additional laser irradiation after contact opening generally degraded the passivation quality with increasing laser shots, and the depth of laser-induced damage was a few micrometers. Interestingly, the PERC cells fabricated using three laser shots had higher efficiency than that produced by one laser shot. This was attributed to the chemical reaction between the silicon and Al paste, resulting in a eutectic alloy and back surface field, which was much thicker than the depth of laser damage. Consequently, the laser damage by the ablation process can be recovered by metallization during the fabrication of PERC cells. The experimental analyses highlighted that the fraction of point contact is a fundamental parameter in the design of PERC cells. The reduction of fraction of point contacts to reduce the recombination losses at rear surface led to an increase of series resistance. Therefore it is necessary to optimize the width and pitch of point contacts for high-efficiency solar cells.

Keywords: