Interface analysis of Ag/n-type Si contacts in n-type PERT solar cells

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Abstract

To increase efficiencies of bifacial solar cells, emitter, back surface field (BSF), and metal patterns must be optimized. We study the influence of paste volume, through multiple prints, of two silver pastes on the contact formation at the rear side of n-type passivated emitter and rear totally diffused (n-PERT) solar cells with two BSF doping profiles. Differences in fingers' electrical properties were found between pastes. Contact resistivity shows a relative difference of 27.6%, partially explained by changes in the silver crystallites formation at the Ag/Si interface and in the crystallites' penetration depth. Variations in crystallites formation and penetration between pastes can reach 38.4% and 48.8%, respectively. Line resistance shows a difference between pastes, appearing as the main cause of an absolute efficiency difference of 2.9%. Fingers' structural and electrical properties are modified by increasing the paste volume. Microstructure analysis reveals that additional metallic printing does not only increase line cross sectional area but also increases the formation of silver crystallites, which can reach a relative increment of 23.9% between first and second prints. Further printing does not necessarily decrease contact resistivity, but reduces line resistance in up to 94.9%, which results in an absolute efficiency increase of 2.2%. In addition, the higher presence of silver oxide in the finger is related to a higher efficiency in the formation of silver crystallites. Finally, BSF doping has an influence in the open circuit voltage, short circuit current density, and contact resistivity, with differences that can reach 8.7 mV, 0.2 mA/cm(2), and 6.1 m omega cm(2), respectively, depending on paste and number of prints.

Palabras clave

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