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Investigation of Deposition Temperature and Time Effect on the Quality of FSF in n-PERT Solar Cells Using Phosphorus Doped Paper Sheets

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ABSTRACT

The generation of phosphorus-diffused Front Surface Fields (FSF) is regarded as a key step in the fabrication of high-conversion-efficiency n-typePERT (passivated emitter rear fully diffused) solar cells. Experimental data show that the applicationof a FSF reduces the total series resistance. The penetration depths in the range of 0.50 µm and 0.81 µm, the dopants surface concentrations are 2.5 E21 cm^{-3} and 1.9 E22 cm^{-3} for n-850 and n-900 °C respectively. The passivation property was studied, and it was discovered that the effective lifetimegrew considerably to127 µs at 900 °C and a deposit period of 20 minutes, and subsequently decreasedto up to 20µs at the same temperature and a deposition time of 6 minutes.

Keywords: n-type silicon solar cells; n-PERT;front surface field (FSF); lifetime (t_{eff}).

Introduction

Because of its great efficiency, n-type crystalline silicon (c-Si) solar cells are now attracting a lot of attention. In this works, we presented front surface field (FSF) optimization for n-PERT[1] (Passivated Emitter Rear Totally-diffused). N-type silicon has longer bulk lifetimes and is less susceptible to metal impurities[2] and light-induced degradation[3]. The primary function of an FSF is to decrease the dark emitter current and therefore raise the open-circuit voltage[4]. This study presents findings for industrially optimizing diffusion (FSF), with a focus on the two parameters temperature and deposition time to obtain high FSF performance.

Experimental

We employed sheet paper (perform source) to examine the FSF quality diffusion throughphosphorus source doped n-type monocrystalline silicon wafers with low resistivity (1 - 3Ωcm). The diffusion process is carried out in the Omega Junior

3 oven of the manufacturer Tempress (Holland).The effect of diffusion temperature and deposition time is investigated.

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Results and Discussion

SIMS and ECV measurements reveal that diffusion by a solid source at 900°C and a deposition period of 20 minutes yields a satisfactory result, which is consistent with minority carrier lifetime data or a good passivation of the surface. The Hall stripping technique we demonstrate that increasing the deposition temperature or duration reduces the Hall mobility, which may be explained by a high doping level. For a doping time of 10 min we have a concentration of 1.83×10^{16} cm^{-3}, a larger fraction of substituted phosphorus.

Conclusion

Sample n-850 had a penetration depth of 0.65 µm and a concentration of 2.5 E21 cm^{-3}, whereas sample n-900 had a depth of 0.81 m and a concentration of1.9 E22cm^{-3}. We investigated the effective lifetime of the minority charge carriers. We achieved lifetime values 127 µs and an open circuit voltage of 634.5 mV using iodine-ethanol passivation at a deposition temperature of 900 ° C and deposition duration of 20 minutes.

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