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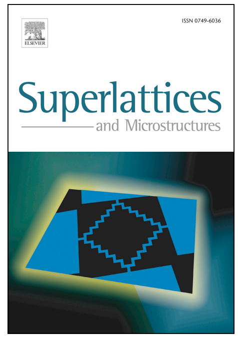

Acoustically driven degradation in single crystalline silicon solar cell

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Acoustically driven degradation in single crystalline silicon solar cell

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Abstract

The influence of ultrasound on current–voltage characteristics of crystalline silicon solar sell was investigated experimentally. The transverse and longitudinal acoustic waves were used over a temperature range of 290–340 K. It was found that the ultrasound loading leads to the reversible decrease in the photogenerated current, open–circuit voltage, fill factor, carrier lifetime, and shunt resistance as well as the increase in the ideality factor. The experimental results were described by using the models of coupled defect level recombination, Shockley–Read–Hall recombination, and dislocation–induced impedance. The contribution of the boron-oxygen related defects, iron-boron pairs, and oxide precipitates to both the carrier recombination and acousto–defect interaction was discussed. The experimentally observed phenomena are associated with the increase in the distance between coupled defects as well as the extension of the carrier capture coefficient of complex point defects and dislocations.

Keywords: silicon, solar cells, ultrasound influence

1. Introduction

The silicon solar cells (SSCs) are still dominant in the photovoltaic field due to their high efficiency, low selling price and process maturity. The material properties driving is a top priority for most of manufacturers of SSC or another semiconductor devices. For example, the loss in the SSC efficiency is observed due to illumination (the light–induced degradation or LID in the c–Si case [1–4] and the carrier-induced degradation or CID in the mc–Si case [5, 6]), high voltage (the potential–induced degradation or PID [7–9]), or irradiation (the radiation–induced degradation or RID [10, 11]). The degradation reason is a changing of crystal defects. That is a transformation of the boron–oxygen or copper–contained complex (in LID case), a decoration of the stacking faults by the positive ions, predominantly sodium, (in PID case) or a creation of the radiation recombination centers (in RID case). The annealing at an elevated temperature is quite often required for efficiency recovery.

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