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Effect of Sn doping on improvement of minority carrier lifetime of Fe contaminated p-type multi-crystalline Si ingot

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Abstract

The influence of Sn doping on improvement of minority carrier lifetime (MCL) of Fe contaminated directionally solidified p-type multi-crystalline Si ingots is studied. The macrostructure and resistivity distribution of the Si ingots indicate that no significant difference exists with and without Sn doping. The average MCL increase by 26.2%, 31.8%, 8.1% with 20ppmw, 40ppmw, 60ppmw Sn doping, respectively. The MCL was improved evidently due to the reduction of formation of interstitial Fe, FeB. The doping of Sn promotes formation of vacancies, which also contributes to passivation of interstitial Fe and FeB. A calculation of constitutional supercooling is carried out, which shows that Fe have great influence on the solidification interface stability, and Sn have little influence on the interface stability.

Key words: A1. Minority carrier lifetime, A1. Doping, A1. Impurities, A2. Directional solidification, B2 Multi-crystalline Si

1. Introduction

It is common sense that metal impurities dramatically reduce MCL, and hence the solar cells efficiency. Especially Fe, one of the lifetime-killing contaminants, which distributes widely in equipment, air, dust and raw materials in industrial production. It generally occupies interstitial sites in the Si lattice and has a fast diffusion rate. There are many Fe related-defects in silicon [1, 2]. In p-type Si, positively charged Fe ions tend to form FeB complexes with negatively charged boron ions at room temperature. The FeB complexes could be a strong recombination center that will reduce MCL and

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