

Investigation of barrier layers on ceramics for silicon thin film solar cells

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Abstract:

Crystalline silicon thin films solar cells made by high temperature deposition on foreign substrate have the potential for reducing the cost through material consumption. The draw-back could be the possible migration of impurities from the substrate to the active layer. Here we investigated the diffusion of contaminants from ceramic substrates, namely mullite and SiAlON using the Deep Level Transient Spectroscopy (DLTS) technique as indirect method of impurity detection in silicon. We have identified Mg, Mn and Fe as the main contaminants. We have also shown that coating the ceramics with ONO or SOG layers reduces drastically the impurities concentrations in silicon. These layers are therefore efficient barrier layers.

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INTRODUCTION

These last years, there are considerable research efforts in the field of thin-film crystalline silicon solar cells based on high temperature deposition of silicon layers on low-cost foreign substrates, namely ceramics like alumina [1] SiAlON [2], SiSiC [3], SiN [4] or more recently mullite [5]. The high temperature approach ($> 900^{\circ}\text{C}$) offers high deposition rates [6] on large area and compatibility with subsequent processes (zone melting recrystallization ZMR, emitter formations oxidation...) for solar cells fabrication. An important question however is whether impurities from the substrate can migrate to the active layer during silicon deposition. Indeed, these contaminants can either be elements from the main components (starting powders) of the substrate material or other species present as impurities in the material. However, it should be remind that many impurities, especially transition metals, have detrimental effect on the performance of Si solar cells. They are harmful already at trace concentrations [7] when they are electrically actives. Techniques with low level detection levels are therefore needed. The Deep Level Transient Spectroscopy (DL TS) is a technique that can offer this possibility [8]

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