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Rear Surface Passivation with Al2O3 Layer by Reactive Magnetron Sputtering for High-Efficiency Silicon Solar Cell

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The electrical loss of the photo-generated carriers is dominated by the recombination at the metal-semiconductor interface. In order to enhance the performance of the solar cells, many studies have been performed on the surface treatment with passivation layer like SiN, SiO2, Al2O3, and a-Si:H. In this work, Al2O3 thin films were investigated to reduce recombination at surface. The Al2O3 thin films have two advantages, such as good passivation properties and back surface field (BSF) effect at rear surface. It is usually deposited by atomic layer deposition (ALD) technique. However, ALD process is a very expensive process and it has rather low deposition rate. In this study, the ICP-assisted reactive magnetron sputtering method was used to deposit Al2O3 thin films. For optimization of the properties of the Al2O3 thin film, various fabrication conditions were controlled, such as ICP RF power, substrate bias voltage and deposition temperature, and argon to oxygen ratio. Chemical states and atomic concentration ratio were analyzed by x-ray photoelectron spectroscopy (XPS). In order to investigate the electrical properties, Al/(Al2O3 or SiO2,/Al2O3)/Si (MIS) devices were fabricated and characterized using the C-V measurement technique (HP 4284A). The detailed characteristics of the Al2O3 passivation thin films manufactured by ICP-assisted reactive magnetron sputtering technique will be shown and discussed.

Keywords: Solar cell, Passivation, BSF, Al2O3, Reactive magnetron sputtering