Electron contact interlayers for low-temperature-processed crystalline silicon solar cells

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Abstract

This study focuses on electron-selective passivating contacts for crystalline silicon (c-Si) solar cells where an interlayer is used to provide a low contact resistivity between the c-Si substrate and the metal electrode. These electron contact interlayers are used in combination with other passivating interlayers (e.g., a-Si:H, TiO₂, and Nb₂O₅) to improve surface passivation whilst still permitting contact resistivities suitable for high efficiency solar cells. We show that a wide variety of thermally evaporated materials, most of which have ionic character, enable an Ohmic contact between n-type c-Si and Al. From this pool of compounds, we observed that CsBr has especially promising behavior because of its excellent performance and thermal stability when combined with thin passivating layers. With different test structures, we were able to demonstrate low contact resistance using TiO₂/CsBr, Nb₂O₅/CsBr and a-Si:H/CsBr stacks on n-type c-Si. The quality of the provided surface passivation depended on the stack but we achieved the best overall passivation stability with TiO₂/CsBr. Finally, we were able to demonstrate an efficiency >20% on a laboratory-scale solar cell that implements the TiO₂/CsBr/Al stack as full-area rear side electron selective contact.

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