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Doping Controlled Emitter with a Transparent Conductor for Crystalline Si Solar Cells

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A transparent conducting oxide (TCO) layer was applied in crystalline Si (c-Si) solar cells without use of the conventional SiNx-coating. A high quality indium-tin-oxide (ITO) layer was directly deposited on an emitter layer of a Si wafer. Three different types of emitters were formed by controlling the phosphorous diffusion condition. A light-doped emitter forming a thinner emitter junction showed an improved photoconversion efficiency of 14.1% comparing to 13.2% of a heavy-doped emitter. This was induced by lower recombination within a narrower depletion region of the light-doped emitter. In the aspect of light management, the intermediate refractive index of ITO is effective to reduce the light reflection leading the enhanced carrier generation in a Si absorber. For the electrical aspect, the ITO layer serves as an efficient electrical conductor and thus relieves the burden of high contact resistance of the light-doped emitter. Additionally, the ITO works as a buffer layer of Ag and Si and certainly prevents the shunting problem of Ag penetration into Si emitter region. It discusses an efficient design scheme of TCO-embedded emitter Si solar cells.

Keywords: Doping controlled, Emitters, Transparent conductor, Crystalline Si, Solar cells