HjT photovoltaic cell total energy cost reduction by energy efficient RF plasma source for a-Si:H thin film deposition

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The main driver for research and development of high-efficiency PV cells is the cost reduction, approached from different perspectives i.e. cost of the device itself, cost of PV-generated electricity as well as the cost of energy used for PV cells production. All those factors contribute to the total balance of the energy produced with PV panel.

Heterojunction solar cells technology (HjT) is a promising high-efficiency cell design which combines the advantages of the crystalline silicon solar cells (high quality absorber) and the silicon thin-film solar cells (amorphous silicon thin-films with transparent conducive oxides as selective contacts). The efficiency of the HjT cell strongly depends on the quality of the intrinsic hydrogenated amorphous silicon (i)a-Si:H thin film. Hydrogen available in (i)a-Si:H film is used to passivate the c-Si surface providing low defect density at the junction. The (i)a-Si:H deposition is routinely performed with a RF (13.56 MHz) PECVD process. The applied plasma power density is mainly driving the dissociation of the hydrogen precursors. Therefore, the quality and efficiency of the applied PECVD plasma source influences not only the deposition rate but can influence the overall performance of the HjT cell by influencing the hydrogen concentration in the (i)a-Si:H film.

This paper presents a comparative study of RF power sources influence on the efficiency of the (i)a-Si:H deposition. The overall cost savings to the energy generation with a PV module will be analyzed from two perspectives: (a) the deposition process yield, and (b) the energy savings for production batch corelated with the plasma source metrics. Key factors enabling at least 25% decrease of the production cost by implementation of energy-efficient PECVD plasma generator will be described in detail.