Improvement of Conversion Efficiency for Solar Cell with Metal-Oxide-Semiconductor Diode

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The energy loss of solar cell due to the recombinat ion of holes and electrons which are excited by the incident solar beam is approximately 20% of all the loss-mechanisms. To recover the energy loss, some promising methods have been researched[1,2]. We presented the novel structure of the solar cell that has the metal-oxide-semiconductor (MOS) diode at the side wall of the electricity generation layer [3]. The purpose of this research is to simulate influence of the field-effect on the recombiner of carriers and show the increase of the conversion efficiency of the solar cell. The configuration of the new solar cell is as follows. The gate electrode and oxide surround the pin or pn stacked layer. If the positive voltage is applied to the gate electrode, the static potential is formed in the stacked layer. The holes and electrons which are excited by the incident solar beam are separated by the drift potential. The holes and electrons move the inside area far from the oxide/stacked layer interface and in the vicinity of the interface, respectively, and it resulted in the decrease of the recombination probability. The simulation is pursuit by the ATLAS, which is the two-dimensional device simulation frame work, by SILVACO. Ltd. Fig. 1 shows the calculated conversion efficiency for the c-Si or p-Si as the function of the gate voltage. It is found that the conversion efficiency increases by the gate voltage application. The increase ratios of the conversion efficiency under the gate voltage application are 1.62 and 1.56 times for c-Si and p-Si in comparison with non-gate application equal to the conventional structure, respectively. And also, it is found that the effect of the gate voltage application on the conversion efficiency becomes remarkable as the life time increases. The reason of this phenomenon is thought to be due to the prevention of the recombination for the excited carriers by the space separation.