결정질 실리콘 태양전지의 전면전극 접촉 특성 연구

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Study of contact property of front grid in screen printed silicon solar cell

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결정질 실리콘 태양전지의 전면 전극은 전극 면적으로 인한 손실(shading loss)를 줄이고 단락전류밀도(Jsc)를 높이기 위해 전극 너비를 줄이는 노력을 하고 있다. 하지만 전극 소성(firing) 시 전면 전극의 핑거(finger)와 버스바(busbar)의 너비 차이로 인해 전극 침투(fire-through) 정도가 달라질 수 있다. 본 연구에서는 전극 소성 공정 시 전면 전극의 너비에 따른 전극 침투 정도를 조사하기 위해 접촉 저항(specific contact resistance)과 재결정화(Ag recrystallite) 된 전면전극의 분포에 대해 비교하였다. 접촉 저항을 측정하기 위하여 transfer length method(TLM)를 이용하였다. 또한 전면 전극층을 제거한 후 실리콘 기판의 재결정 분포를 주사전자현미경(Scanning electron microscope : SEM)을 이용하여 관찰하였다.

Key words : specific contact resistance(접촉 저항), glass frit, front grid(전면 전극), transfer length method, scanning electron microscope(주사전자현미경), crystalline silicon solar cell(결정질 실리콘 태양전지)

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ZnO 박막의 구조적, 전기적, 광학적 특성간의 상관관계를 고려한 박막태양전지용 투명전극 최적화 연구

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Optimization of ZnO-based transparent conducting oxides for thin-film solar cells based on the correlations of structural, electrical, and optical properties

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Transparent conducting oxides (TCOs) are of significant importance for their applications in various devices, such as light-emitting diodes, thin-film solar cells, organic light-emitting diodes, liquid crystal displays, and so on. In order for TCOs to contribute to the performance improvement of these devices, TCOs should have high transmittance and good electrical properties simultaneously. Sn-doped In_2O_3 (ITO) is the most commonly used TCO. However, indium is toxic and scarce in nature. Thus, ZnO has attracted a lot of attention because of the possibility for replacing ITO. In particular, group III impurity-doped ZnO showed the optoelectronic properties comparable to those of ITO electrodes. Al-doped ZnO exhibited the best performance among various doped ZnO films because of the high substitutional doping efficiency. However, in order for the Al-doped ZnO to replace ITO in electronic devices, their electrical and optical properties should further significantly be improved. In this connection, different ways such as a variation of deposition conditions, different deposition techniques, and post-deposition annealing processes have been investigated so far. Among the deposition methods, RF magnetron sputtering has been extensively used because of the easiness in controlling deposition parameters and its fast deposition rate. In addition, when combined with post-deposition annealing in a reducing ambient, the optoelectronic properties of Al-doped ZnO films were found to be further improved.

In this presentation, we deposited Al-doped ZnO ($ZnO:Al_2O_3$ = 98:2 wt%) thin films on the glass and sapphire substrates using RF magnetron sputtering as a function of substrate temperature. In addition, the ZnO samples were annealed in different conditions, e.g., rapid thermal annealing (RTA) at 900 °C in N_2 ambient for 1 min, tube-furnace annealing at 500 ℃ in $N_2:H_2$=9:1 gas flow for 1 hour, or RTA combined with tube-furnace annealing. It is found that the mobilities and carrier concentrations of the samples are dependent on growth temperature followed by one of three subsequent post-deposition annealing conditions.

Key words : Transparent conducting oxides(투명전극), zinc oxide(아연산화물), thin-film solar cells(박막태양전지)

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