Electrodeposited Cuprous oxide based p-n junction for photovoltaic devices with atomic layer deposited ZnO layers

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초 록: 저온 공정을 통한 저가형의 태양전지를 만들기 위해 ALD 공정 법으로 Zinc oxide의 전도성을 조절하여 전기 증착법을 통해 성장시킨 Cuprous oxide와 p-n heterojunction을 구성하고 태양전지를 제작하였을 때 최적의 효율을 확인하였다. 전도성이 낮아질수록 전착법과의 p-n junction에서의 Jsc값이 증가하여 100도의 Zinc oxide의 경우 0.13%의 태양전지 효율을 보였다.

1. 서론

Cuprous oxide (Cu_2O) is an attractive material as absorber layers of photovoltaic devices, because it has direct band gap energy of 2.1 eV and high absorption coefficient, which make it possible to fabricate thin film solar cells with n-type material such as ZnO. Cu_2O absorber layers have been prepared by several techniques such as Cu thermal oxidation, sputtering, and electrodeposition. Among these methods, electrodeposition is particularly attractive process because of its simplicity, scalability, and economy. Up to date, electrodeposited cuprous oxide on the n-type ZnO was studied in several ways, but although the electrodeposition technique is affected by substrate conductivity, the study on the effect of ZnO conductivity on the electrodeposited cuprous oxide is insufficient.

2. 본론

In this study, we electrodeposited the Cu_2O layers on the ITO/glass substrates coated with the ZnO that was deposited atomic layer deposition (ALD). The electrical conductivity of ZnO can be easily controlled by the temperature of ALD process; 100, 125, and 150 ^{o}C. Solution pH of 11.0 was used with 4M sodium hydroxide solution and electrodeposition was potentiostatically carried out at -0.4V and 333K. And then, Ni and Au bilayers were deposited by e-beam evaporator on the Cu_2O as an electrode to confirm the effect of electrical conductivity of n-type ZnO on the I-V characteristics in p-n juction. The properties of Cu_2O thin films were characterized by X-ray diffraction (XRD) and scanning electron microscope (SEM). The Cu_2O layer on a high conductive ZnO underlying layer showed slight rectifying behavior, while the use of a low conductive ZnO layer induced rectifying behavior. These results are attributed to the change of interfacial built-in potential by ZnO conductivity. EQE curve of Cu2O/ZnO/ITO heterojunction is increased at 450~600 nm with decreasing of ZnO deposition temperature. Aslo efficiency of the Cu2O/ZnO heterojunction solar cell is increased with decreasing of ZnO conductivity.

3. 결론

We have fabricated a Cu2O/ZnO solar cell by using electrdeposition & atomic layer deposition. This polycrystalline structure shows an excellent electrical rectifying behavior and solar cell efficiency of 0.13%. In spite of good open circuit voltage, 0.3V, short circuit current is very low, 1.63mA/cm^2 because of poor electrical property of Cu2O. Therefore decrease of the resistivity of Cu2O is necessary to improve the electrodeposited Cu2O/ZnO solar cell efficiency.

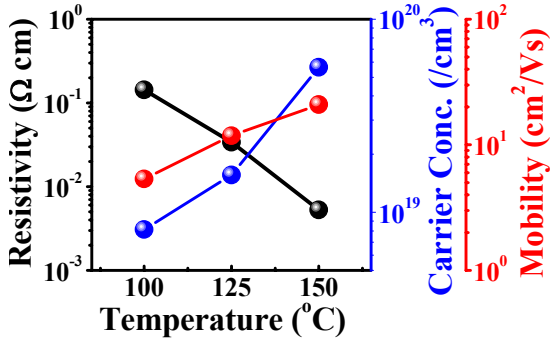

Fig. 1. Electrical property of ZnO

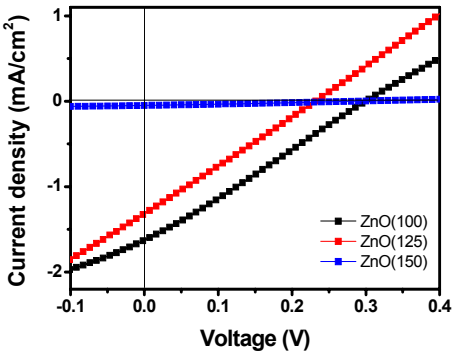

Fig. 2. Solar cell efficiency with ZnO conductivity

참고문헌

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