플렉시블 CIGS 태양전지 제조를 위한 저온 나노입자공정

**박 진호, Umme Farva, Rangarajan Krishnan, 박 준영, Timothy J. Anderson

Low Temperature Nanopowder Processing for Flexible CIGS Solar Cells

**Chinho Park, Umme Farva, Rangarajan Krishnan, Jun Young Park, Timothy J. Anderson

$CuIn_{1-x}$-$GaxSe_2$ based materials with direct bandgap and high absorption coefficient are promising materials for high efficiency hetero-junction solar cells. CIGS champion cell efficiency(19.9%, AM1.5G) is very close to polycrystalline silicon(20.3%, AM1.5G). A reduction in the price of CIGS module is required for competing with well matured silicon technology. Price reduction can be achieved by decreasing the manufacturing cost and by increasing module efficiency. Manufacturing cost is mostly dominated by capital cost. Device properties of CIGS are strongly dependent on doping, defect chemistry and structure which in turn are dependent on growth conditions. The complex chemistry of CIGS is not fully understood to optimize and scale processes. Control of the absorber grain size, structural quality, texture, composition profile in the growth direction is important to achieving reliable device performance. In the present work, CIS nanoparticles were prepared by a simple wet chemical synthesis method and their structural and optical properties were investigated. XRD patterns of as-grown nanopowders indicate CIS(Cubic), $CuSe_2$(orthorhombic) and excess selenium. Further, as-grown and annealed nanopowders were characterized by HRTEM and ICP-OES. Grain growth of the nanopowders was followed as a function of temperature using HT-XRD with overpressure of selenium. It was found that significant grain growth occurred between 300-400℃ accompanied by formation of β-$Cu_{2-x}Se$ at high temperature(500℃) consistent with Cu-Se phase diagram. The result suggests that grain growth follows VLS mechanism which would be very useful for low temperature, high quality and economic processing of CIGS based solar cells.

Key words : CIGS solar cell(구리-인듐-갈륨-셀레나이드계 태양전지), Thin film solar cell(박막태양전지), Nanopowder (나노입자), Flexible substrate(플렉시블 기판)

E-mail : ** chpark@ynu.ac.kr

실리콘 태양전지용 Ag pastes 에서의 무연 프릿에 따른 Ag, Si간 접촉 형성

*김 동선, 황 성진, 김 종우, 이 정기, **김 형순

Contact Formation Between Ag and Si With Lead-Free Frits in Ag Pastes For Si Solar Cells

*Dongsun Kim, Seongjin Hwang, Jongwoo Kim, Jungki Lee, **Hyungsun Kim

Ag thick-film has usually been used for the front electrode of Si solar cells with the outstanding electrical properties. Ag paste consists of Ag powers, vehicles, frits and additives. Ag paste has broadly been screen-printed on the front side of Si wafer with the merits of low cost and simplicity. The optimal contact formation between Ag electrodes and Si wafer in the front electrode during a fast firing has been considered as the key factor for high efficiency. Although the content of frit in Ag pastes is less than 5wt%, it can profoundly influence the contact formation between Ag and Si under the fast firing. In this study, the effects of lead-free frits on the contacts between Ag and Si were studied with the thermal properties and compositions of various frits. Our experimental results showed that the electrical properties of cells were related to the interface structures between Ag and Si. It was found that current path of electrons from Si to Ag would be possible through the tunneling mechanism assisted by tens of nano-Ag recrystals on n^+ emitter as well as Ag recrystals penetrated into n^+ emitter layers. These preliminary studies will be helpful for designing the proper frits for the Ag pastes with considering the properties of various Si wafers.

Key words : Si solar cells, Ag pastes, Lead-free frits, Contact formation

E-mail : * evergreendsk@gmail.com, ** kimhs@inha.ac.kr