

EM-P027

A Facile Strategy to Fabricate TiO₂ Nanostructures with Controllable Crystalline Polymorphs and Morphologies and Their Photoelectrochemical Applications

최민기, 용기중

POSTECH

TiO₂는 저렴한 가격, 적절한 bandgap, 열적, 화학적, 생물학적 안정성 등으로 촉망받는 광촉매 물질이다. TiO₂는 rutile (tetragonal, space group: P42/mnm), anatase (tetragonal, space group: I41/amd), and brookite (orthorhombic, space group: Pbcn)의 3가지 대표적인 결정구조를 가지고 있다. Rutile과 anatase는 1972년 Fujishima와 Honda가 TiO₂의 광촉매 특성을 발견 한 후로 아주 많은 연구가 되어왔다. 반면 brookite의 경우는 자연에 거의 존재하지 않으며, 합성방법도 어려워서 rutile과 anatase에 비해 많은 연구가 되지 않았다. 본 연구에서는 brookite를 포함한 다양한 TiO₂ 나노구조를 간단한 수열합성법으로 티타늄 호일 위에 합성하였다. 합성된 TiO₂는 반응 온도와 시간, additive의 농도에 따라서 sheet, tube, wire, pyramidal 의 4가지 morphologies를 가졌다. 이 다양한 morphologies은 SEM과 TEM으로 분석되었으며, 각 물질의 결정 구조는 XRD분석과 TEM의 SAED pattern 분석으로 sheet, tube, wire은 anatase, pyramidal 구조는 brookite라는 것이 확인 되었다. 위의 방법으로 합성된 각각의 TiO₂ 물질들을 working 전극으로, Pt와 Ag/AgCl을 reference와 counter 전극으로 만들어서 photoelectrochemical 특성을 측정해서 비교를 해보았을 때, brookite 물질이 anatase보다 더 좋은 photoelectrochemical 특성을 나타내는 것을 확인하였다.

Keywords: TiO₂, brookite, photoelectrochemical

EM-P028

Heterojunction Quantum Dot Solar Cells Based on Vertically Growth TiO₂ Anatase Nanorod Arrays with Improved Charge Collection Property

Hyun Suk Chung, Gill Sang Han, So Yeon Park, Dong Geon Lee, Hyun Suk Jung

School of Advanced Materials Science and Engineering, Sungkyunkwan University, Korea

The Quantum dot (QD) solar cells have been under active research due to their high light harvesting efficiencies and low fabrication cost. In spite of these advantages, there have been some problems on the charge collection due to the limitation of the diffusion length. The modification of advanced nanostructure is capable of solving the charge collection problem by increasing diffusion length of electron. One dimensional nanomaterials such as nanorods, nanowires, and nanotubes may enhance charge collection efficiency in QD solar cells. In this study, we synthesized TiO₂ anatase nanorod arrays with length of 200 nm by two-step sol-gel method. The morphology and crystal structure for the nanorod were characterized by using scanning electron microscopy (SEM), transmission electron microscopy (TEM), and X-ray diffraction (XRD). The anatase nanorods are single-crystalline and possess preferred orientation along with (001) direction. The photovoltaic properties for the heterojunction structure QD solar cells based on the anatase nanorod were also characterized. Compared with conventional TiO₂ nanoparticle based QD solar cells, these nanostructure solar cells exhibited better charge collection properties due to long life time measured by transient open circuit studies. Our findings demonstrate that the single crystalline anatase nanorod arrays are promising charge transport semiconductors for heterojunction QD solar cells.

Keywords: Quantum dot, TiO₂, nanostructure, charge collection