Sol-gel Derived Vertically Aligned Anatase TiO_2 Nanotubes using Polycarbonate Membranes as Templates for Dye-sensitized Solar Cells

허성연, 안성훈, 노동규, 전하림, 김종학*
연세대학교
(jonghak@yonsei.ac.kr*)

We first introduce the facile method of making anatase TiO_2 nanotube (NT) stand by using sol-gel process and polycarbonate (PC) membrane as a hard template. In an attempt to fabricate vertically aligned TiO_2 NT, three different types of Ti precursors (titanium isopropoxide, titanium chloride and titanium n-butoxide) were used. Although use of two solutions based titanium isopropoxide and titanium chloride were failed, solution based titanium n-butoxide precursor succeeded in making NT stand, showing thickness of 5.9㎛, as confirmed by scanning electron microscope (SEM). Vertically aligned TiO_2 NT contributed to the fast electron transport, thereby leading to the highest efficiency (1.81%) among three samples. This result was revealed by intensity-modulated photocurrent spectroscopy (IMPS) and intensity-modulated photovoltage spectroscopy (IMVS) analysis. The other TiO_2 NT photoanode without vertical structure showed a lower solar cell efficiency. We also compared TiO_2 NT and TiO_2 NT coated with nanoparticle (NP), verifying the advantage of the one-dimensional (1D) structure. As expected, TiO_2 NT coated with NP exhibited better efficiency (3.83%) than pristine NP (2.95%) due to the well-ordered morphology of 1D nanostructure.