【심포지움-광촉매 03】

Effect of Surface Modification of Nanocrystalline Oxide Semiconductors on Photovoltaic Properties in Dye-Sensitized Solar Cells

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We have investigated the effects of surface-modification of nanocrystalline semiconducting oxides on photovoltaic characteristics in dye-sensitized solar cells. Nanocrystalline SnO_2 and TiO_2 particles were treated with alkali, alkaline earth or transition metal ions ranging from 0 to 20 mol%, which was deposited on a transparent conducting glass and annealed at 500 °C in air. In some cases, surface-modification was performed by dipping the annealed films in the dopant-contained solution. X-ray diffraction and scanning electron microscopy studies confirm that crystal structure and morphology of the pristine nanocrystalline oxides are hardly changed by surface modification. On the other hand, the current-voltage measurements under one sun light illumination show that surface modifications have a significant influence on the photoelectrochemical properties. We have found that photocurrent and voltage depend on the doping concentration and doped elements. For the case of nanocrystalline SnO_2, photocurrent increases with increasing the doping concentration, reaches the maximum value and then decreases, whereas voltage increases with increasing the concentration. Surface-modification of nanocrystalline TiO_2 increases voltage but decreases photocurrent with increasing the doping concentration. Data analysis suggests that the surface-modification might alter the energetics of the oxide/liquid interface (or the space charge layer), which probably control the open-circuit voltage, the recombination and the charge-injection efficiency.