Modified hydrolysis of TiO_2 particle for dye sensitized TiO_2 solar cell

Young Cheol Lee, Young Jin Jung, Ha Yong Lee, Young Pyo Hong, Kyung Hyun Ko
Department of Materials Science and Engineering,
Ajou University, Suwon 442-749, Korea

There are several mechanisms of energy degradation of light-harvested electricity in dye sensitized TiO_2 solar cell(DSSC) such as low ohmic contact between TiO_2 and TCO, recombination of injected electron from Ru-dye with electrolyte and so on. In general, to enhance the efficiency of DSSC, TiO_2 electrode has been processed via nano-powder synthesis technology resulting anatase TiO_2 layer with high surface area. During hydrolysis of TiO_2 powder, the popular way to prepare TiO_2 electrode, specific surface area is highly sensitive to pH of processing solution.

For preparation of pure anatase and nano-sized TiO_2 powder in this study, combined catalytic treatment of acidic (HCl) and basic (NH_4OH) were employed. Specific surface area of TiO_2 powder was determined by primary particle size, packing density and secondary particle size. Acidic treatment has tendency to form fine primary particle size and to enhancing rutile transformation. However, more loose packing density and fine secondary particle distribution as well as retardation of rutile transformation were found when basic catalyst used. When acidic catalyst firstly applied followed by basic catalysts, pure anatase phase was obtained and the combined set of primary size, packing density and secondary size was optimal. Consequently, the photovoltaic efficiency was far better than those formed by single acidic or basic treatment were applied. But reverse sequence of catalytic agent resulted in undesirable surface area, (anatase + rutile) mixed state and reducing of photovoltaic efficiency.