Modified hydrolysis of TiO$_2$ particle for dye sensitized TiO$_2$ solar cell

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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$_4$OH) 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.