# Highly active photocatalyst based on TiO2 nanomaterials

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Titanium dioxide (TiO2) is a representative material for photocatalysis, and its form of nanoparticle as well as their composite to thin film are very attractive products to the environmental and energy issues. One of the world-spread application of photocatalysis is self-cleaning exterior such as tile and glass on the building and house. The outdoor applications, on which the photocatalysis was irradiated by sunlight including ultraviolet wavelength, were quite well utilized. Turning to the interior application and the highly efficient photocatalysis, the visible-light active photocatalysts are highly required. Chen et al. reported the black TiO2 in 20111). Oxygen vacancies were induced in TiO2 nanoparticles, and therefore their color changed from the pristine white to black. Two factors of keeping nano-sized structure and inducing oxygen vacancy only around sub-surface of TiO2 nanoparticles enhanced the oxidation of organics in water and the hydrogen evolution by reducing water with the use of a sacrificial reagent. In this study, we demonstrate the solution plasma processing (SPP) to treat the starting TiO2 nanoparticles instead of the hydrogenation process by Chen et al., in which the photocatalysts were treated in hydrogen atmosphere of 2 MPa at 200□C for 5 days. Not

only the replacement of manufacturing process but the novel photocatalysts were investigated using of SPP and adapting some starting TiO2 materials such as anatase, rutile and their mixtures. TiO2 nanoparticles (Anatase: ST-01 from Ishihara Sangyo, Rutile: MT150A from Tayca, Mixture: P25 from Aerosil) were dispersed in KCl aqueous solution. After 3 hours treatment, the photocatalytic performance of plasma-treated samples was evaluated by the complete decomposition of acetaldehyde under fluorescent lamp with 8,000 lx. Final product of gaseous acetaldehyde decomposed by photocatalytic reaction is carbon dioxide (CO2), and the stoichiometric ration between acetaldehyde and CO2 is 1:2. As a result, TiO2 treated by the SPP for 3 h showed a high gaseous photocatalytic performance (91.1%) for acetaldehyde degradation to CO2 compared with the activity of untreated TiO2 (51%). The SPP-treated TiO2 was also more active than nitrogen-doped TiO2 driven by visible light (66%). The SPP technique could be used to enhance the activity of readily available feedstocks with a short processing time2). These results demonstrate the potential of this method for modifying narrow-band gap metal oxides, metal sulfides, and polymer composite-based catalyst materials. The modifications of these materials are not limited to acetaldehyde degradation and could be used in a wide range of VOC pollutant removal applications.

**References**

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