
Pengembangan Nanomaterial Berbasis TiO₂ yang Memiliki Sifat Super-Hidrofilik dan Fotokatalitik serta Aplikasinya Sebagai Material Swa-Bersih dan Anti-Kabut

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Air pollutant, dust, oily deposits, mold, bacteria and other particulates, that abundance in some kind of area can easily form a contamination and dirt on various outdoor glasses, window glasses, mirror, tiles (bathroom, kitchen, floor, building walls, etc) and other materials. Difficulty in cleaning of these materials at many locations as well as highly costs of maintenance (detergent, man power, etc) are problems should be solved. Fogging formation on the various kinds of mirror or glasses of automotive and other various accessories at particular location and condition is another interesting problem to be worked out.

Titanium dioxide (TiO₂) photocatalyst which has been known as a strong oxidation agent in organic degradation process actually also demonstrates a hydrophilic property that can effectively be applied as anti fogging material. Moreover, the hydrophilic material can also exhibit a self-cleaning effect. Numerous kinds of the impurities that adhere on the surface of photocatalytic as well as hydrophilic material will be degraded and furthermore can be washed easily or even they clean themselves. Synergism effect of the photocatalytic and hydrophilic properties will be more significant if the TiO₂ crystalline is in the range of nanosize particle. This research aims to synthesize and conduct a performance test of the TiO₂-based nanocrystal (target of crystallite size < 25 nm) which exhibit a super-hydrophilic property in self-cleaning and anti fogging material.

Film types of TiO₂ have been synthesized through sol-gel method that modified with PEG and SiO₂ as doping substrates. TiO₂ sols subsequently coated on the surface of support materials (glass/mirror, tiles, and plastic film) by spray coating or spin coating method followed by calcinations at certain temperature. In order to determine the characteristics of the materials, some characterizations were carried out by XRD, DRS, SEM, FTIR and BET. Hydrophilic property of the materials was measured by means of Contact Angle Meter. Anti fogging as well as self-cleaning tests were applied on the TiO₂-coated materials of glasses/plastic film and floor tiles, respectively.

Experimental results showed that TiO₂ nanomaterial which prepared by low temperature crystallization have a small crystallite size with the range of 5-10 nm, rutile phase composition of 0-34%, specific surface area of 144-264 m²/g, pore size of 37-60 Å, and band gap energy of 3,18-3,43 eV. Material which prepared by high temperature crystallization have a relatively similar crystallite size ranging from 4 to 11 nm, but no rutile phase, specific surface area up to 248 m²/g, and band gap energy of 3,17-3,28 eV. Addition of PEG and SiO₂ simultaneously could improve the hydrophilic property, specific surface area, and photocatalytic activity as well as lowering the crystallite size of the materials. The optimum composition of the nanomaterial has been provided concerning with the self-cleaning and anti fogging applications.

Modified TiO₂ nanocrystal as synthesized samples could be coated properly over various kinds of support materials like as tiles, glasses, mirror, plastic film, etc. These materials exhibit the excellent super-hydrophilic (contact angle of < 5°) and photo-catalytic properties, therefore it has a wide potential applications. The result of various investigations proved that the materials coated by modified TiO₂ nanocrystal demonstrate the effective multi-functions, at least as an *anti fogging, self-cleaning, and self-sterilizing*.