SYNTHESIS OF TRANSPARENT TiO2 THIN FILM WITH ENHANCED ANTI-STATIC SELF-CLEANING PROPERTIES WITH USAGE ON GLASS-SUBSTRATE

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ABSTRACT

Dust removal is a major problem .There are a lot of ways for dust removal that two major ways are mentioned. First one is the natural dust removal, TiO_2 has potential for self-cleaning usage due to its anti-static property. The self-cleaning property of Titanium dioxide is due to the synergy of its own photocatalytic properties activated by solar light. This article reported synthesis of transparent thin-film TiO_2 by combination of sol-gel process and the Deep-coat method. Anti-static Nano films were characterized by means of Scanning electron microscope (SEM), contact-angle test (CA), photocatalyst test, Ultraviolet-visible spectroscopy (UV-vis), real-time dust test and X-ray diffraction (XRD). It received from the SEM test that the average particle size is about 50nm, And the particles are spread the same on surface and have equal properties. XRD results showed that the crystal structure of the synthesized TiO2 layer is anatase. The UV-vis test showed that the TiO2 thin-film can remove organic material in intervals of 1 hour and a maximum of 5 hours up to 60%, and this shows the efficiency of the material. The contact-angle obtained from the film shows a 90% difference from the non-coated surface. In photocatalyst test, the Photocatalytic property appeared and its High efficiency It was specified that TiO_2 thin films showed enhanced photocatalytic efficiency compared with non-filmed surfaces. Real-time dust test compares non-coated and coated surfaces for their real-time anti-dust efficiency, moreover it obtained from the test that coated surface shows a massive anti-dust property comparing to the non-coated one. The obtained anti-static photocatalytic TiO_2 nano-film showed excellent photocatalytic and anti-static properties.

OBJECTIVES

This project was started to improve and achieve new and important goals, which can be mentioned as :

DUST REMOVAL

COMMERCIAL USE

LONG LASTING

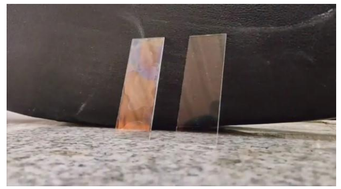
WIDE USAGE

CAPABILITY IN DIFFRENTS SITUATIONS

USAGE ON DISPLAYS

METHODES AND DETAILS

For the synthesis of TiO2 nanoparticles with photocatalytic and antistatic properties by sol-gel method, 99.9% ethanol from Qadir Company, Merck Titanium Isopropoxide (TTIP), Merck Polyethylene Glycol (PEG) and Merck Hydrochloric Acid (HC) were used. In order to make TiO2 nanoparticles, 1cc of Titanium Isopropoxide was mixed with 5g of ethanol, and for this purpose, a 50-round styler was used. To increase the reaction rate and make the material finer, a solution consisting of 10 cc of ethanol and 2 cc of HCL, plus 0.3 g of Polyethylene Glycol was used and mixed with the primary solution for 20 minutes in 50° C by using a Magnetic Stirrer. After 20 minutes, it was observed that the solution was clear and the tuberculosis was ready. 3cc of the synthesized material was layered on the metal surface and placed at room temperature for 24 hours. The morphology of coated TiO2 was studied by FESEM (camscan MV2300). TiO2 structure was studied by XRD (Philips PW3040/60). UV-Vis spectrophotometer (PG Instruments Ltd., T80) used for UV-Vis test. Photocatalyst test was performed under visible light irradiation using a 400 W visible metal haled lamp (OSRAM, Germany) with a UV cut-off filter. The distance of the lamp from the sample was 15 cm.



Coated Substrate compared with Non-Coated Substrate

RESULTS

Purely synthesized TiO2 contains anatase Titanium Oxide phase. Structural analysis of TiO2 particles has been done by using XRD test. Diffraction diagrams was measured at 2θ and in range of 20°-60°. Figure .1 shows XRD patterns. The Sol was heated at 500° C for two hours. The TiO2 substance in XRD test reaches a peak at 1800 in intensity, in range of 24°-26°. These results indicate the pure anatase phase of the material.

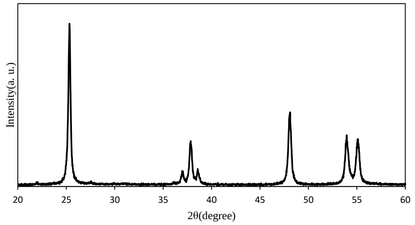


Figure (1): XRD test

As shown in the FESEM test, results were obtained in the tests. In Figure .2, the particle size is in nanometres and the spherical particle shape is in the maximum particle size about 100 nanometres. A uniform-layered material can be mentioned that creates the properties on the whole surface.

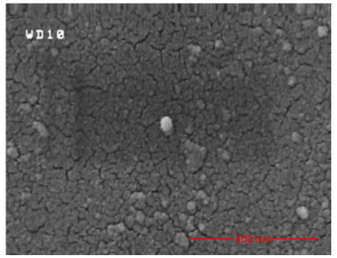


Figure (2): SEM image of the material

In the contact angle test, as shown in figure .3 (a), substrate without any coating the contact angle of the drop on is about 46.78, and in figure .3 (b), coated-substrate this angle is reduced to 4.86, which indicates the hydrophilicity of the surface that gives the ability to use the mentioned properties as follow anti-static and self-cleaning properties.

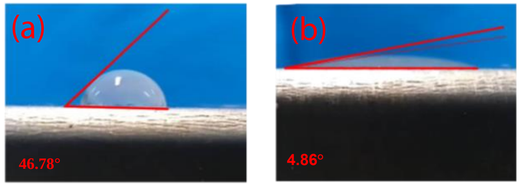


Figure (3): Contact angle test

In UV-Vis test with the provided photocatalyst test, it was found that TIO2 thin-film coated on the glass substrate has the ability to decompose organic material, including germs and viruses. The test was taken in five, one and a half hour intervals, which compared to the sample shows the loss of methyl-blue in these time intervals.

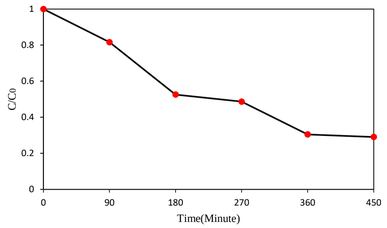


Figure (4): UV-Vis test

The real-time dust test shows High efficiency anti-static and self-cleaning properties. As shown in figure .6, left side of the glass-substrate figure .6 (a) has been coated by TiO2 thin film and right-side figure .6 (b) has been not coated. To simulate dust particles dry gypsum powder used, that is quite close to dust particles in terms of dimensions and adhesion and is even more adhesive.

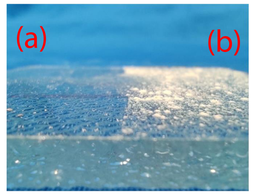


Figure (6): real-time dust test

CONCLUSION

Synthesis of TiO2 nanoparticles was performed by sol-gel method. From the SEM test of the material, results related to its uniformity and particle size, particle sphericity and dimensions of about 100 nanometers were obtained. The contact angle test showed that the surface material was completely hydrophilic, which means that the surface is dust-resistant and has self-cleaning property. Photocatalyst test, performed at intervals of 1 to 4 hours and exposed to UV light, showed that the substance has photocatalytic properties and destroys organic material, which also includes viruses. The contact angle test indicates that the surface is hydrophilic, which indicates the self-cleaning anti-static properties. Due to the mentioned properties, especially antistatic and photocatalytic properties, the material can be used in general environments or exposed devices, and especially in glass-based devices.

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