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Research Article

Hydrothermal Deposition Of $TiCL_4$ Solution To Produce TiO_2 Particles On The Surface Of Meranti Wood *(Shorea Sp)*

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ABSTRACT
Thin layer of TiO_2 on wood surface was made by precipitation of TiO_2 particles from the hydrolysis of $TiCl_4$ which was acidified with HCl for 1 hour at a temperature of 80^{O}C. Prior to this treatment, Meranti wood was cut 2 mm thin and soaked using 0.5 mmol / l surfactant sodium dodecyl sulfate (SDS) for 2 hours at 80^{O}C. The sample is put into a reactor containing 0.5 mol/l $TiCl_4$ and HCl solution. The $TiCl_4$ solution was previously prepared by adding $TiCl_4$ to cold distilled water and stirring slowly. The structure of TiO_2 crystals distributed on wood surfaces was analyzed using the XRD aiming at analyzing the morphology of thin films coating using SEM and EDS. Penetration The number of TiO_2 particles deposited on a wooden surface is seen in the form of rutile and anatase structures. The results of EDX (X-ray Energy Dispersion Spectroscopy) showed the presence of TiO_2 particles formed and also the interaction of TiO_2 particles with water on the surface of the wood.

Keywords: wood, TiO_2 deposition, Aqueous $TiCl_4$ solutions, XRD, SEM EDX

INTRODUCTION

Wood could be a porous and sinewy auxiliary tissue found within the stems and roots of trees and other woody plants. Wood is one of the foremost plenteous biopolymers. Alongside great potential since it combines huge mechanical quality and warm separator properties. Weather-affected wood experiences degradation (Hermansyah & Munaf, 2016), mainly due to the effects of light and water. Wood degradation due to sunlight occurs fairly quickly on exposed wood surfaces (Yan, ZeHui, Ge, & Ye, 2010). As a result, decomposed lignin causes physical, chemical and biological damage to wood (Rassam, Abdi, & Abdi, 2012a). Lignin decomposition in surface wood cells causes wood discoloration as a result of photo degradation (Todaro, D'Auria, Langerame, Salvi, & Scopa, 2015). The open surface of the wood allows the water content in the wood pore to decrease quickly so that the surface of the wood is influenced by environmental factors and becomes drier, so that it causes an increase in the hardness and thickness of the wood (Rassam et al., 2012a). Many methods have been carried out to reduce the impact caused by weathering wood and items made of wood with pre-treatment such as the wood heat treatment process (Nybakk, Hansen, & Treu, 2015), The use of hydrophobic materials on solid wood structures, Coating a thin layer on the surface of the wood allows the wood to remain in high humidity and able to withstand radiation from UV (Temiz, Terziev, Eikenes, & Hafren, 2007). Such thin film deposition can be achieved by cold plasma chemical vapor deposition (Temiz et al., 2007) or by sol-gel process deposition. Recently, nano materials have been used in wood structures to improve wood stability (Wang, Feng, & Zhan, 2014). Coating hardwood structures with ZnO nanocomposites can enhance the photostability of wood and have anti-fungal ability (Mahr, Stephan, & Militz, 2012). TiO2 that is deposited in wood in humid conditions can increase wood's resistance to mold. The application of TiO2 nanoparticles into wood is carried out by the hydrothermal deposition method so that the particles are not only deposited on the surface of the wood but enter the wood pore (Boutra, 2013). Because of their respective properties, TiO_2 nanoparticles have become attractive candidates as catalysts for photochemical water (Kusiak-Nejman & Morawski, 2019) and air purification (Sun et al., 2010). Many ways that can be done to apply in making anti-UV, self cleaning, anti-fungal and anti-bacterial ingredients (Sun, Lu, & Liu, 2017). Many methods are used to prepare TiO_2 nanoparticles, such as thermal oxidation or anodic Ti, dipping or spin coating and vapor deposition chemicals (Pori et al., 2016). The resistance of UV and light radiation from wood

coated with TiO2 was studied in this study (Ohno, Sarukawa, & Matsumura, 2002). Also, modifications to the structure of wood studies have been studied by scanning electron emission field microscopy (SEM) (Pori et al., 2016).

EXPERIMENTAL

Planning of TiO2/wood tests, Pieces of Meranti wood (Shorea sp) With measurements of 25mm × 25 mm × 2mm (length, Width, Tallness) were utilized. All tests were cleaned with refined water. To begin with, wood tests are impregnated by plunging in a 0.5 mmol/l anionic surfactant arrangement of Sodium Dodecyl Sulfate (SDS, Sigma Aldrich) for 2 hours at 80°C. It ought to be famous that SDS has been utilized to create TiO2/hydrophobic wood surfaces, but SDS is applied on TiO_2/ wood that has been prepared surface and not on bare wood (Schneider, Niegisch, Mennig, & Schmidt, 2004), as is done here (Sun et al., 2017). Subsequently analysis with SDS, the test was washed with refined water and dried in an stove at 100OC for 5 minutes. The test is put into a reactor containing 0.5 mol/l TiCl4 (Sigma Aldrich) HCl (Sigma Aldrich) arrangement. The TiCl4 arrangement was already arranged by including TiCl4 to cold refined water and mixing gradually. The included HCl arrangement with an HCl concentration of 0.5 mmol/l. The proportion of mass between TiCl4 arrangement and including HCl arrangement is 1: 1. The test is plunged within the arrangement for up to 1 hour at at 75°C. The sample was then heated to 120°C for 2 hours to form TiO_2 nanoparticles (Pori et al., 2016). Wood with a layer of TiO_2 looks pale white because TiO_2 is applied transparently and the actual particles cannot Detect by the bare eye. For XRD range estimations, tests with a layer of TiO2 particles are washed with refined water and after that dried in an broiler at 100°C for 5 minutes and after that cleared out in room surrounding until a consistent mass is come to (Rassam, Abdi, & Abdi, 2012b).

RESULTS AND DISCUSSION

a. XRD analysis for the TiO_2 phase

XRD characterization Aims to see the crystal structure of the TiO_2 catalyst by knowing the sample peaks and compared with the standard peaks. This is very important to know because the main catalyst used is not pure TiO_2, so to find out whether this material has fully formed TiO_2. The sample analyzed was meranti wood coated with TiO_2 catalyst, with a sample size of 25 x 25 x 2 mm. Then the analysis uses X-Ray Cu Anode, voltage 40 kV, current strength 30 mA and diffraction range (2Θ) = 5 - 80°.

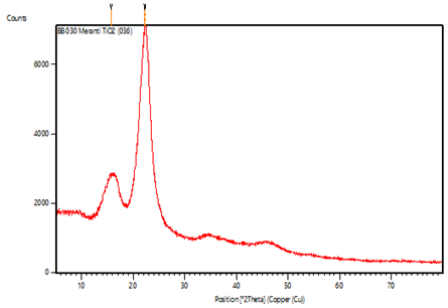


Fig.1: XRD analysis to see the TiO2 phase

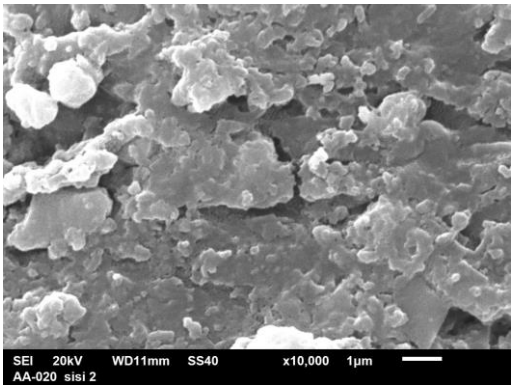
From Figure 1 XRD Diagram above, it can be seen that at positions 15.71 and 15.75 have peak heights from the data are 759 and 379. This proves that there are TiO_2 Crystals formed by the rutile Crystal structure (Fujishima, Rao, & Tryk, 2000). While at 22,285 and 22,341 peak data peaks were 3689 and 1845, this proves the existence of TiO_2 crystals formed by the Anatase structure . So, obviously, there are $TiCl_4$ and HCl reactions in the formation of TiO_2 (Lee & Liu, 2002), namely:

$$TiCl_4 + HCl + 5H_2O \longrightarrow Ti(OH)_4 + 5HCl + H_2O$$

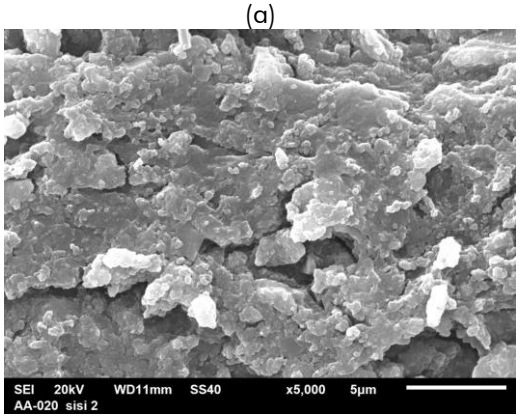
$$Ti(OH)_4 \xrightarrow{\Delta} TiO_2 + 2H_2O$$

b. SEM analysis

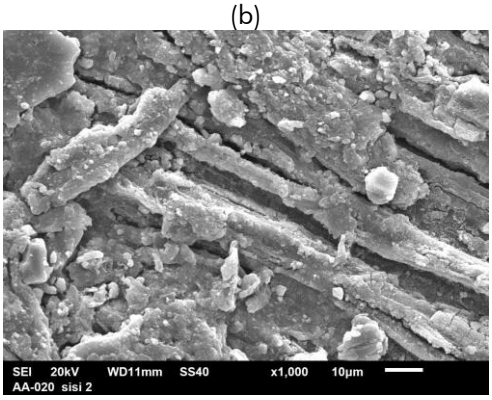
Electron Microscopes (SEM, JEOL 5500 LV, Joel) are utilized to look at aqueous stores on the test surface and on cross segments of wood. All tests were coated with gold lean movies (Sputter Coater SCD 005, Baltec). The example is filtered in a vacuum and an speeding up voltage of 20 kV. To relate the real sum of TiO2 shaped on the wood surface as anticipated, SEM analysis was carried out in Figure 2. sample. (a), (b) and (c) Examination of SEM micrographs confirms that there are a number of TiO_2 formed with magnification of 1µm, figures (b) and (c) magnifications of 5µm and 10µm respectively. The particles have deposited on the surface of the wood (Piedad-beneitez, 2007), the particles seen in the SEM image also enter the wood pore so that an even layer is formed on the surface of the wood, which can also be easily observed at magnification of 10µm (Bergamasco et al., 2011). It cannot produce rutile TiO2 from aqueous TiCl4 solution at low temperatures (Nakata & Fujishima, 2012).



(a)



(b)



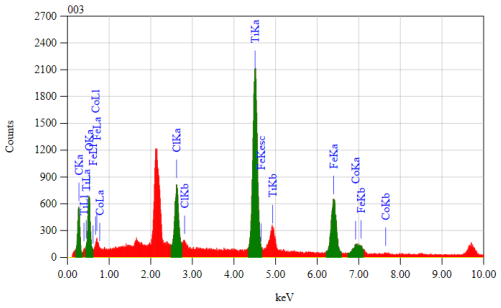
(c)

Fig.2:SEM micrograph of sample three times magnification

c. EDX Analysis (Energy Dispersion Spectroscopy)

Quantitative investigation and profile of titanium concentrations within the cross-section of the test in figure 2 were carried out by X-ray Vitality Dispersive Spectroscopy (EDX, Oxford Disobedient) utilizing the INCA computer program. The genuine procurement time for quantitative

EDX analysis is around 100 seconds, while for line analysis is between 400 and 600 seconds. EDX quantitative analysis is carried out taking into account all elements of the analysis. EDX line analysis of Titanium was carried out on meranti wood with a sample size of 25 x 25 x 2 mm which had previously been treated to obtain hydrophobic properties using sodium dodecyl silphate (SDS) then coated using $TiCl_4$ solution.



ZAF Method Standardless Quantitative Analysis
Fitting Coefficient : 0.5603

Element	(keV)	Mass%	Error%	Atom%	Compound	Mass%	Cation	K
C K	0.277	16.38	0.27	31.54				5.9725
O K	0.525	29.95	1.19	43.30				17.2202
Cl K	2.621	4.67	0.22	3.04				7.5037
Ti K	4.508	27.54	0.42	13.30				39.9571
Fe K	6.398	18.18	0.81	7.53				24.9109
Co K	6.924	3.28	1.01	1.29				4.4355
Total		100.00		100.00				

Fig.3: Concentration profiles for titanium obtained by EDX

From figure.3. Can be seen the results obtained are the presence of Titanium particles that are positioned on the surface of the wood, and also there is still Carbon, Oxygen and Chlorine found on the surface of meranti wood (shorea sp). The method of shaping TiO2 in wood considerate with aqueous in a arrangement of TiCl4/HCl can be visualized as takes after; At first, the hydrolysis of TiCl4 was for the arrangement of the TiOH complex, where the number of distinctive ligands depends on the corrosiveness and concentration of the Cl-in arrangement (Sun et al., 2017). The fact that H_2O from precursors or H_2O in wood can act as a ligand for the latter. Besides the presence of titanium particles, there are still Fe, Co, Cl and Oxygen particles. Amid the development of titania particles, it can effectively be connected not as it were to the surface of the wood but to develop interior the wood. appearing nearly indistinguishable ghastly highlights as recorded for the test. We trust typically since aqueous treatment continuously begins with drenching wood and impregnating with the titanium hydroxochloro complex with by intuitive and hemicellulose and the structure of a few complex forms. better with titanium powder and also titanium solutions.

CONCLUSION

The presence of titania particles with anatase and rutile structures in this sample was seen in XRD analysis, where treatment was carried out under easy conditions. SEM images showed the presence of Titanium particles positioned on the surface and in meranti wood (Shorea sp). Particle growth was not recorded in SEM but on EDX analysis which showed distributed particles on the surface and also in wood pores. Combined action of wood immersion / impregnation with particle

formation on wood surfaces It is important to increase the dimensional stability of wood, while SDS is needed to create multi-storey structures consisting of rutile and wooden floors with super hydrophobic surfaces. Good distribution of particles on the surface of wood can be continued to support photochemical reactions.

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