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PHOTOCATALYST COATING OF MNO-FE$_2$O$_3$/PS FROM NATURAL MATERIALS

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ABSTRACT

The present invention relates to an Photocatalyst coating of MnO-Fe$_2$O$_3$/PS from natural materials. Photocatalyst is a method for reducing liquid pollutant materials using ultraviolet (UV) light to produce oxidizing and reducing species on the surface of the catalyst. The catalyst used is MnO-Fe$_2$O$_3$/PS. The tools used are HEM-3D (High Energy Milling Ellipse-3D Mention), XRF (X-Ray Fluorescene), XRD (X-Ray Difraction) and SEM (Scanning Electron Microscope). The precursors were made by adding 0.5 grams of polystyrene and 0.4 grams of MnO powder and Fe$_2$O$_3$ powder. The coating is carried out by using the spin coating method and temperature variations using a furnace. The result of this research is that the MnO-Fe$_2$O$_3$/PS nanocomposite coating made has the best photocatalytic properties at a temperature of 60ºC with a grain size of 168.73 nm. photocatalyst coating of nanocomposite MnO-Fe$_2$O$_3$/PS to produce an energy gap of 2.4 electron volts.

Keywords: *Photocatalyst, MnO, Fe$_2$O$_3$, PS.*

1. INTRODUCTION

Research on nanocomposites continues to develop in line with the development of Science and Technology. One of the developments is that nanocomposite can be used to synthesize the photocatalyst layer. Photocatalysis is a method for reducing liquid pollutants that utilize Ultraviolet (UV) light to produce oxidizing and reducing species on the surface of the catalyst [1-7]. Catalyst is a substance that affects the reaction rate process without changing it chemically. The catalyst can accelerate photoreaction through its interaction with the substrate, either grounded or excited, or with the main photoproduct, depending on the photoreaction mechanism [8-11].

In applying the photocatalytic properties a coating is required. Coatings that have the photocalist properties of semiconductor particles are a current research trend. This coating is able to degrade dirt / waste quickly by utilizing sunlight. The material coated with this photocatalyst material is said to have self-cleaning properties. This coating material can be TiO2, Fe2O3, ZnO, WO3, and CdS, ZnS, CuS, FeS [12-13]. However, in this study the researchers used Fe2O3 because this semiconductor material has the ability to be photocatalyst so that it can accelerate light-induced oxidation reactions. This ability is owned by Fe2O3 due to its band gap of 2.2 eV which facilitates the excitation of electrons from the valence band to the conduction band. Currently iron ore (fe2O3) continues to be developed so that with this large amount it can be utilized as well as possible, while manganese oxide (MnO) is widely used to coat metals in addition to protecting it from rusting, but it also has tough properties that can be used for reinforcement. other metals. In the MnO / fe2O3 photocatalyst process it is very necessary in impurities (dopants), the impurity used is polystyrene so that the elemental energy present in the valence band can be excited to the conduction band so that MnO has better purity and quality. Katalis is divided into 2 types, namely non-metal and metal dopants. Transition metal oxides, for example Fe2O3 with Eg = 2.2 eV [14-16].

2. LITERATURE REVIEW

Research on nanocomposites continues to develop in line with the development of Science and Technology [17]. One of the developments is that nanocomposite can be used to synthesize the photocatalyst layer. Photocatalysis is a method for reducing liquid pollutants that utilize Ultraviolet (UV) light to produce oxidizing and reducing species on the surface of the catalyst [19-20]. Catalyst is a substance that affects the reaction rate process without changing it chemically[21-22]. The catalyst can accelerate photoreaction through its interaction with the substrate, either grounded or excited, or with the main photoproduct, depending on the photoreaction mechanism [23-24].

3. EXPERIMENTAL

Sample to be used is 0.4 gram of iron ore which will be used to obtain nanohematite (Fe2O3) [25]. The iron ore is crushed using a mortar until it passes a 200 mesh sieve and is heated at a temperature of 9000C. The heating result is then refined to get the size of hematite in nanometer scales using a HEM (Haig Energy Milling) tool for 5 hours [26].

Furthermore, the manufacture of Manganese nanoparticles by preparing 0.4 grams of manganese will be used to obtain manganese oxide (MnO). Manganese is crushed using a mortar until it passes a 200 mesh sieve and is heated at a temperature of 8500C. The heating results are then mashed to obtain tenorite measurements in nanometer scales using a HEM (Haig Energy Milling) tool for 20 hours. After that we made the process of making MnO / PS / Fe2O3 nanocomposite layer by preparing 15 ml of Tetrahydrofuran (THF), 0.1 g of PEG and 2 g of Polystyren, put into a 100 ml beaker, then the nanohematite PS, Fe2O3) and MnO were added to the first mixture. The mixture is stirred using a magnetic stirrer at a speed of 500 rpm for 60 minutes, the goal is to mix all the components evenly and form an MnO-Fe2O3 nanocomposite gel. The weights of MnO and Hematite (Fe2O3) were varied 1: 3, 2: 2, and 3: 1 [27-28].

In the manufacture of substrate preparations, the substrate used in this research is glass preparations. The preparatory glass is cut to a size of 1 cm x 1 cm. The glass was washed with alcohol using an Ultrasonic cleaner for 2 hours. The purpose of this washing is to prevent dirt, dust, grease and other particles from sticking to the substrate. Nanocomposite coating using spin coting technique is done by dropping the substrate with nanocomposite gel so that the entire surface is covered. The substrate was then rotated with a spin coating rate of 1000 rpm within 60 s. The sample was heated at a temperature of 60 0C- 4000C. In this research, several tools are needed, namely XRD to determine the particle size of MnO / PS / Fe2O3, crystal structure and to ensure that Mn, Fe and PS are in the Thin Layer of MnO / PS / Fe2O3 Nanocomposites. Characterization of SEM (Scanning Electrone Microscope) equipped with EDX (Energy Dispersive X-ray Spectroscopy). SEM was used to see the surface morphology and particle thickness size of the MnO / PS / Fe2O3 Nanocomposite Thin Layer. EDX was used to determine the substance content of the MnO-Fe2O3 / PS Nanocomposite thin layer. The UV-VIS spectrophotometer was used to see the effect of the duration of irradiation in degrading impurities which was known from the measurement of the absorbance value [29].

4. RESULTS AND DISCUSSION

The synthesis photocatalized layers nanocomposite MnO-Fe2O3 / Polyestiren as follows:

a. 0.4 grams of iron oxide will be used to get nanohematite (Fe2O3). The iron oxide is crushed using a mortar until it passes a 200 mesh sieve and is heated at a temperature of 9000C. The heating result is then refined to get the size of hematite in nanometer scales using a HEM (Haig Energy Milling) tool for 5 hours.

b. 0.4 grams of manganese will be used to get manganese oxide (MnO). Manganese is crushed using a mortar until it passes a 200 mesh sieve and is heated at a temperature of 8500C. The heating results are then mashed to obtain tenorite measurements in nanometer scales using a HEM (Haigh Energy Milling) tool for 20 hours.

c. prepare the nanocomposite layer, prepare 15 ml of Tetrahydrofuran (THF), 0.1 g of PEG and 2 g of Polystyren, put into a 100ml beaker, then add the nanohematite PS, Fe2O3) and MnO into the first mixture. The mixture is stirred using a magnetic stirrer at a speed of 500 rpm for 60 minutes, the goal is to mix all the components evenly and form an MnO-Fe2O3 nanocomposite gel. The weights of MnO and Hematite (Fe2O3) were varied 1: 3, 2: 2, and 3: 1.

d. The substrate preparation used in this research was glass preparations. The preparatory glass is cut to a size of 1 cm x 1 cm. The glass was washed with alcohol using an Ultrasonic cleaner for 2 hours. The purpose of this washing is to prevent dirt, dust, grease and other particles from sticking to the substrate.

e. Nanocomposite coating using spin coting technique is done by dropping the substrate with nanocomposite gel so that the entire surface is covered. The substrate was then rotated with a

f. spin coating rate of 1000 rpm within 60s. The sample was heated at a temperature of 60 0C-4000C.

g. Effect of the duration of nanocomposite irradiation in degrading impurities is done by: Making a 10 mg / L Methyl Orange (MO) impurity solution by dissolving 0.01 gr MO into 1000 ml distilled water [30]. The result of the solution is taken as much as 15 ml and then put into the test tube. Into the test tube containing MO, the sample is inserted. Furthermore, the tube containing the sample and MO is dried under the hot sun. Drying time in the sun for 4 hours

The result of this research is that the MnO-Fe_2O_3/PS nanocomposite coating made has the best photocatalytic properties at a temperature of 60ºC with a grain size of 168.73 nm. photocatalyst coating of nanocomposite MnO-Fe_2O_3/PS to produce an energy gap of 2.4 electron volts.

5. CONCLUSION

The result of this research is that the MnO-Fe2O3/PS nanocomposite coating made has the best photocatalytic properties at a temperature of 60ºC with a grain size of 168.73 nm. photocatalyst coating of nanocomposite MnO-Fe2O3/PS to produce an energy gap of 2.4 electron volts.

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