Degradasi rhodamine B menggunakan perpanjangan zona katalisis dari sel surya tersensitasi zat warna termodifikasi = degradation of aqueous rhodamine B by catalysis zone extension of modified dyes sensitized solar cell

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Abstrak

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Peningkatan kesadaran akan ancaman polusi lingkungan mendorong pengembangan pengolahan limbah yang lebih efisien dan berkesinambungan. Material semikonduktor TiO2 merupakan material yang diharapkan memegang peranan penting dalam penyelesaian permasalahan polusi lingkungan melalui pemanfaatan energi matahari berbasis perangkat fotovoltaik termodifikasi. Sistem hibrid Dye Sensitized Solar Cell (DSSC)-katalisis merupakan salah satu pendekatan penyelesaian permasalahan limbah dikarenakan dapat mengoksidasi berbagai senyawa limbah serta pengaktifan dalam jangkauan panjang gelombang sinar tampak menyebabkan sistem ini menjadi lebih efisien.

Pada penelitian ini, fabrikasi sistem hibrid DSSC-katalisis menggunakan TiO2 nanotube yang disintesis melalui teknik Rapid Breakdown Anodization pada beda potensial 15 V dalam elektrolit 0,15 M HClO4. Pengujian performa sistem hibrid DSSC-katalisis menggunakan simulasi limbah rhodamine B dalam air. Beberapa variasi yang dilakukan adalah zat warna yang digunakan, perbandingan luas daerah warna dan daerah katalisis, serta perbandingan komposisi campuran fase anatase-rutil dalam TiO2. Variasi ini dilakukan untuk mengetahui kondisi optimum device DSSC-katalisis dalam mendegradasi rhodamine B.

TiO2 hasil sintesis dikalsinasi pada suhu 400°C selama 3 jam dan 2 jam serta 500°C selama 3 jam, lalu dikarakterisasi menggunakan XRD, UV Vis DRS, FTIR, FESEM, dan EDX. Hasil karakterisasi UV-Vis DRS menunjukkan band gap TiO2 hasil sintesis berkisar antara 3-3,5 eV. Sementara hasil uji FTIR yang menunjukkan ada puncak spesifik disekitar daerah 400-700 cm-1. Pada FESEM EDX, terlihat hasil yang cukup baik dalam bentuk bundle nanotube yang membuktikan bahwa teknik RBA dapat digunakan dalam proses sintesis TiO2 nanotube.

TiO2 hasil sintesis digunakan untuk merangkai sistem hibrid DSSC-katalisis menggunakan rhodamine B dan ekstrak buah naga sebagai zat warnanya. Zona katalisis pada hibrid DSSC diuji aktivitas katalisisnya, dimana persen degradasi oleh sistem bersensitizer rhodamine B sebesar 65,22% dan ekstrak buah naga sebesar 34,78% dengan lama penyinaran masing-masing 60 menit. Hal ini menunjukkan bahwa dalam sistem ini, rhodamine B memberikan hasil yang lebih baik. Pengujian selanjutnya menggunakan sensitizer rhodamine B dengan variasi perbandingan luas zona warna dan zona katalisis sebesar 1:2, 1:1, dan 1:0,5 dan diperoleh persen degradasi berturut-turut 40,19%; 25,01% ; dan 9,59%. Dengan demikian perbandingan optimum pada variasi ini adalah luas zona warna dan katalis yang paling baik adalah 1:2. Pengujian ketiga menggunakan TiO2 dengan komposisi campuran fase kristal anatase rutil sebesar 100% anatase 0% rutil.
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ABSTRACT
An increasing concern on environmental pollution lead to development for more efficient and sustainable waste treatment. Titanium dioxide is expected to play an important role to solve the environmental pollution problem by using solar energy based on modified photovoltaic devices. Hybrid Dye Sensitized Solar Cell (DSSC) -catalysis system may become an efficient approach to solve the problem not only causes of the oxidizing power to degrade almost organic non biodegradable compounds in the waste but also the activation energy of this system still in visible light range. In this study, fabrication of hybrid DSSC - catalysis system used TiO2 nanotubes which was synthesized by Rapid Breakdown Anodization method, the potential difference was 15 V in 0.15 M HClO4. Degradating ability testing for hybrid DSSC ?catalysis system using simulated waste rhodamine B dispersed in water. Several variations has been done as kind of the dye used for the system, the wide comparison of dyes zone and catalytic zone, and composition of mixed crystalline phase ratio of anatase and rutile in TiO2 used. The purpose of the variation was to determine the optimum conditions for DSSC - catalysis device in degrading rhodamine B. TiO2 synthesized was calcined up to 400 ° C for 3 hours and 2 hours and 500°C for 3 hours. It was characterized using XRD, UV- Vis DRS, FTIR, FESEM, and EDX. UV- Vis DRS showed the band gap of samples between 3-3.5 eV. The result of FTIR measurements showed there was peak around the region 400-700 cm-1. FESEM EDX results showed very good shape of TiO2 nanotube bundle which proves that the RBA technique can be used in the synthesis process. Testing for determine the better sensitizer between rhodamine B and dragon fruit extract has been done. Based on the results of UV Vis measurements, percent degradation of rhodamine B system up to 65.22% and dragon fruit extract only 34.78%. Each of them exposure by visible light for 60 minutes. It indicates that in this system, rhodamine B sensitizer gives the better results. Further testing using sensitizer rhodamine B with a wide comparison of dye zone and catalytic zones by 1: 2, 1: 1 and 1: 0.5 and obtained percent of degradation respectively 40.19%; 25.01%; and 9.59%. Thus the optimum ratio in this variation is 1: 2. The third testing using the composition of the mixture TiO2 anatase-rutile crystalline phase 100% anatase 0% rutile, 92.88% anatase 7.12% rutile and 17.08% anatase 82.92% rutile with a percent of degradation for each sample were 66.80%, 81.01%, and 70.37%. The test results showed that the best phase in the system is the mixture of anatase 92.88% rutile 7.12%. Based on the three variations known that the system would work better if using rhodamine B as a;An increasing concern on environmental pollution lead to development for more efficient and sustainable waste treatment. Titanium dioxide is expected to play an important role to solve the environmental pollution problem by using solar energy based on modified photovoltaic devices. Hybrid Dye Sensitized Solar Cell (DSSC) -catalysis system may become an efficient approach to solve the problem not only causes of the oxidizing power to degrade almost organic non biodegradable compounds in the waste but also the activation energy of this system still in visible light range. In this study, fabrication of hybrid DSSC - catalysis system used TiO2 nanotubes which was synthesized by Rapid Breakdown Anodization method, the potential difference was 15 V in 0.15 M HClO4. Degradating ability testing for hybrid DSSC ?catalysis system using simulated waste rhodamine B dispersed in water. Several variations has been done as kind of the dye used for the system, the wide comparison of dyes zone and catalytic zone, and composition of mixed crystalline phase ratio of anatase and rutile in TiO2 used. The purpose of the variation was to determine the optimum conditions for DSSC - catalysis device in degrading rhodamine B. TiO2 synthesized was calcined up to 400 ° C for 3 hours and 2 hours and 500°C for 3 hours. It was characterized using XRD, UV- Vis DRS, FTIR, FESEM, and EDX. UV- Vis DRS showed the band gap of samples between 3-3.5 eV. The result of FTIR measurements showed there was peak around

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