

## **Sintesis Elektroda Grafit/NiO/Ni dan Grafit/SiO<sub>2</sub>/NiO/Ni Untuk Elektrooksidasi *Remazol Black 5***

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### **INTISARI**

Elektroda grafit merupakan salah satu material karbon yang digunakan sebagai anoda dan katoda, memiliki aktivitas oksidasi senyawa organik yang rendah, dan mudah mengalami korosi. Oleh karena itu perlu dilakukan deposisi dengan elektrokatalis NiO/Ni dan SiO<sub>2</sub>/NiO/Ni untuk meningkatkan aktivitas dan stabilitas. Penelitian ini bertujuan untuk memperbaiki sifat grafit sebagai elektroda pada reaksi elektrooksidasi *remazol black 5*.

Sintesis elektroda grafit/NiO/Ni dilakukan secara elektrodposisi pada kondisi variasi pH yaitu 8, 10, dan 12. Sintesis elektroda grafit/SiO<sub>2</sub>/NiO/Ni dilakukan dengan elektrodposisi NiO/Ni dari larutan NiSO<sub>4</sub>·6H<sub>2</sub>O dan elektrodposisi SiO<sub>2</sub> dari larutan TMOS pada pH 10. Elektroda grafit, grafit/NiO/Ni, dan grafit SiO<sub>2</sub>/NiO/Ni dikarakterisasi menggunakan XRD, SEM-EDX, TEM, FTIR, GSA, dan CV. Pengujian aktivitas elektroda grafit, grafit/NiO/Ni, dan grafit/SiO<sub>2</sub>/NiO/Ni dilakukan pada elektrooksidasi *remazol black 5* dan limbah tekstil pada kondisi variasi waktu, pH, konsentrasi NaCl, dan luas permukaan geometri elektroda.

Hasil karakterisasi XRD, SEM-EDX, TEM, dan FTIR menunjukkan elektrokatalis NiO/Ni dan SiO<sub>2</sub>/NiO/Ni telah terdeposit pada permukaan grafit. Hasil pengujian dengan CV dan GSA menunjukkan elektroda grafit/SiO<sub>2</sub>/NiO/Ni memiliki kemampuan elektrokatalitik dan luas permukaan yang paling tinggi dibandingkan elektroda grafit dan grafit/NiO/Ni. Kondisi optimum elektrooksidasi *remazol black 5* menggunakan elektroda grafit/NiO/Ni dan grafit/SiO<sub>2</sub>/NiO/Ni yaitu pada pH 4, NaCl 0,05 M, selama 60 menit dengan *remazol black 5* terdegradasi sebesar 100 mg.L<sup>-1</sup>, sedangkan untuk elektroda grafit sebesar 99,81 mg.L<sup>-1</sup>. Persentase efisiensi penurunan COD tertinggi sebesar 83,13; 87,99; 88,96; 88,48; dan 92,85% masing-masing untuk grafit; grafit/NiO/Ni pH 8; pH 10; pH 12; dan grafit/SiO<sub>2</sub>/NiO/Ni. Persentase efisiensi penurunan COD terendah sebesar 67,57; 70,98; 72,44; 71,95; dan 75,83% masing-masing untuk grafit; grafit/NiO/Ni pH 8; pH 10; pH 12; dan grafit/SiO<sub>2</sub>/NiO/Ni. Analisis LCMS menunjukkan hasil elektrooksidasi *remazol black 5* terdiri atas senyawa naftalena, aromatik, asam oksalat, dan alifatik. Elektroda grafit/SiO<sub>2</sub>/NiO/Ni mampu mendegradasi limbah tekstil dengan persentase efisiensi penurunan absorbansi, COD, dan amonia masing-masing sebesar 96,93; 99,27; dan 92,38% selama 240 menit proses elektrooksidasi. Berdasarkan hasil penelitian ini, grafit/SiO<sub>2</sub>/NiO/Ni berpotensi digunakan sebagai elektroda anoda pada proses elektrodgradasi *remazol black 5* dan limbah tekstil.

Kata kunci: elektrokatalis, grafit/NiO/Ni, grafit/SiO<sub>2</sub>/NiO/Ni, elektrooksidasi, *remazol black 5*, limbah tekstil

## **SYNTHESIS OF GRAPHITE/NiO/Ni AND GRAPHITE/SiO<sub>2</sub>/NiO/Ni ELECTRODES FOR ELECTROOXIDATION OF REMAZOL BLACK 5**

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### **ABSTRACT**

Graphite electrode is one of the carbon materials used as an anode and cathode, has low oxidation activity of organic compounds, and is easier to corrosion. Therefore, it is necessary to coat it with electrocatalyst NiO/Ni and SiO<sub>2</sub>/NiO/Ni to increase activity and resistance. This study aims to improve the properties of graphite as an electrode in the electrooxidation reaction of remazol black 5.

The graphite/NiO/Ni electrodes were synthesized by electrodeposition at various pH conditions, namely 8, 10, and 12. The graphite/SiO<sub>2</sub>/NiO/Ni electrodes were synthesized by electrodeposition of NiO/Ni from NiSO<sub>4</sub>·6H<sub>2</sub>O solution and SiO<sub>2</sub> electrodeposition from TMOS solution at pH 10. Graphite, graphite/NiO/Ni, and graphite/SiO<sub>2</sub>/NiO/Ni electrodes were characterized using XRD, SEM-EDX, TEM, FTIR, GSA, and CV. The activity test of graphite, graphite/NiO/Ni, and graphite/SiO<sub>2</sub>/NiO/Ni electrodes was carried out on the electrooxidation of remazol black 5 and textile waste under various conditions such as variation time, pH, NaCl concentration, and geometry surface area of the electrodes.

The results of the characterization of XRD, SEM-EDX, TEM, and FTIR showed that the electrocatalysts NiO/Ni and SiO<sub>2</sub>/NiO/Ni had been deposited on the graphite surface. The voltammetry and GSA test results showed that graphite/SiO<sub>2</sub>/NiO/Ni electrodes had the highest electrocatalytic activity and surface area compared to graphite and graphite/NiO/Ni electrodes. The optimum condition for electrooxidation of remazol black 5 using graphite/NiO/Ni and graphite/SiO<sub>2</sub>/NiO/Ni electrodes was at pH 4, NaCl 0.05 M, for 60 minutes with remazol black 5 was degraded 100 mg.L<sup>-1</sup>, while for graphite electrodes was 99.81 mg.L<sup>-1</sup>. The highest COD removed efficiency percentage was 83.13; 87.99; 88.96; 88.48; and 92.85% respectively for graphite, graphite/NiO/Ni pH 8; pH 10; pH 12; and graphite/SiO<sub>2</sub>/NiO/Ni. The lowest COD removed efficiency percentage was 67.57; 70.98; 72.44; 71.95; and 75.83% respectively for graphite, graphite/NiO/Ni pH 8; pH 10; pH 12; and graphite/SiO<sub>2</sub>/NiO/Ni. LCMS analysis showed that the degradation products consisted of naphthalene, aromatic, oxalic, and aliphatic acids. Graphite/SiO<sub>2</sub>/NiO/Ni electrodes were able to degrade textile waste with the percentage efficiency of removed in absorbance, COD, and ammonia respectively 96.93; 99.27; and 92.38% for 240 minutes of the electrooxidation process. Based on the results of this study, graphite/SiO<sub>2</sub>/NiO/Ni had the potential to be used as anode electrodes in the electrochemical degradation process of remazol black 5 and textile waste.

**Keywords:** electrocatalyst, graphite/NiO/Ni, graphite/SiO<sub>2</sub>/NiO/Ni,  
electrooxidation, remazol black 5, textile waste