

Sintesis dan karakterisasi nanokomposit grafena tereduksi agNPs / oksida sebagai katalis karboksilasi fenilasetilen dengan CO₂ =
Synthesis and characterization of agNPs / oxide-reduced graphene nanocomposites as carboxylation catalyst of phenylacetylene with CO₂

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Abstrak

ABSTRAK

Grafena adalah alotrop karbon yang kristalnya tersusun secara heksagonal dengan hibridisasi sp². Grafena dan nanokompositnya dengan berbagai logam transisi telah dikembangkan untuk berbagai aplikasi, mulai dari sensor, elektronik, energi hingga bidang biomedis. Selain itu, nanokomposit berbasis graphene juga banyak dikembangkan untuk aplikasinya sebagai katalis karena memiliki luas permukaan yang besar serta memiliki konduktivitas dan stabilitas yang baik. Pada penelitian ini, graphene oxide (rGO) tereduksi yang dimodifikasi dengan nanopartikel Ag disintesis sebagai katalis heterogen dalam reaksi karboksilasi antara fenilacetylene dan CO₂. Karakterisasi nanokomposit AgNPs / graphene oxide tereduksi dilakukan dengan menggunakan Scanning Electron Microscopy - Spektroskopi sinar-X dispersif energi, Fourier Transform Infra Red, X-ray Powder Diffraction dan UV-Vis Spectroscopy. Berdasarkan hasil UV-Vis didapatkan puncak absorbansi pada panjang gelombang 253 nm yang menunjukkan adanya restorasi konjugasi elektronik pada permukaan rGO. Spektrum FTIR dari nanokomposit AgNPs / rGO menunjukkan penurunan intensitas absorbansi gugus hidroksil dan keton dibandingkan dengan spektrum oksida graphene, menunjukkan bahwa reduksi gugus fungsi yang mengandung oksigen telah berhasil dilakukan dengan menggunakan urea. Hasil XRD menunjukkan intensitas puncak pada 38.14° (111), 44.27° (200), 64.43° (220), 77.38° (311), menunjukkan bahwa nanopartikel Ag yang terbentuk memiliki kristalografi fcc. Hasil SEM-EDX menunjukkan nanopartikel Ag tersebar di permukaan rGO dengan persentase massa 38,57%. Reaksi karboksilasi dilakukan dalam reaktor batch dengan variasi basa dan suhu. Berdasarkan hasil analisis produk menggunakan HPLC, luas produk utama terbesar yang diperoleh dari reaksi menggunakan basa Na₂CO₃ adalah 204,1361 dan suhu 50°C adalah 128,2214. Sedangkan luas produk minor terbesar diperoleh dari reaksi menggunakan basa Cs₂CO₃ sebesar 6,2175 dan suhu 80 °C sebesar 18,3130.

ABSTRACT

Graphene is an allotrope of carbon whose crystals are arranged hexagonally by sp² hybridization. Graphene and its nanocomposites with various transition metals have been developed for a wide range of applications, from sensors, electronics, energy to biomedical fields. In addition, graphene-based nanocomposites have also been widely developed for applications as catalysts because they have a large surface area and have good conductivity and stability. In this study, reduced graphene oxide (rGO) modified with Ag nanoparticles was synthesized as a heterogeneous catalyst in the carboxylation reaction between phenylacetylene and CO₂. Characterization of reduced AgNPs / graphene oxide nanocomposites was performed using Scanning Electron Microscopy - Energy dispersive X-ray spectroscopy, Fourier Transform Infra Red, X-ray Powder Diffraction and UV-Vis Spectroscopy. Based on the UV-Vis results, the absorbance peak was obtained at a wavelength of 253 nm which indicated the presence of electronic conjugation restoration on the rGO

surface. The FTIR spectrum of the AgNPs/rGO nanocomposite showed a decrease in the absorbance intensity of the hydroxyl and ketone groups compared to the graphene oxide spectrum, indicating that the reduction of oxygen-containing functional groups was successfully carried out using urea. XRD results showed peak intensities at 38.14° (111), 44.27° (200), 64.43° (220), 77.38° (311), indicating that the Ag nanoparticles formed had fcc crystallography. The SEM-EDX results showed that Ag nanoparticles were scattered on the surface of rGO with a mass percentage of 38.57%. The carboxylation reaction was carried out in a batch reactor with variations in base and temperature. Based on the results of product analysis using HPLC, the largest area of the main product obtained from the reaction using the base Na_2CO_3 was 204.1361 and a temperature of 50°C was 128.2214. Meanwhile, the largest minor product area was obtained from the reaction using the base Cs_2CO_3 of 6.2175 and a temperature of 80°C of 18.3130.