

Studi Reaksi Reduksi CO₂ Menjadi Senyawa Kimia Bernilai Tambah Menggunakan Katalis Ni₅Ga₃/MC Termodifikasi Ag = Study of CO₂ Reduction Reaction Into Value Added Chemical Compounds Using Ag Modified Ni₅Ga₃/MC Catalyst

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Abstrak

Reaksi hidrogenasi CO₂ dilakukan melalui katalis bimetalik Ni-Ga dan Ni-Ga termodifikasi Ag yang didukung pada karbon mesopori (MC). MC berhasil disintesis menggunakan metode soft-template dengan menggunakan phloroglucinol sebagai prekursor karbon dan pluronik F-127 sebagai template. Katalis Ni-Ga dan Ni-Ga yang termodifikasi Ag disintesis menggunakan metode impregnasi dengan variasi Ni₅Ga₃/MC, Ni₅Ga₃Ag_{0,1}/MC, Ni₅Ga₃Ag_{0,3}/MC, dan Ni₅Ga₃Ag_{0,5}/MC. Berdasarkan karakterisasi XRD, pembentukan bimetal Ni-Ga dan nanopartikel Ag pada penyangga MC telah terkonfirmasi. Gambar mapping EDX menunjukkan Ni-Ga maupun NiGa-Ag terdistribusi secara merata pada permukaan MC. BET-SAA menunjukkan ukuran diameter pori katalis Ni₅Ga₃/MC dan Ni₅Ga₃Ag_{0,1}/MC masing-masing adalah 5,5 nm dan 6,0 nm yang mana termasuk dalam ukuran mesopori 2-50 nm. Aktivitas katalis dalam reaksi hidrogenasi CO₂ dilakukan pada reaktor fixed-bed. Pada katalis Ni₅Ga₃/MC dan Ni₅Ga₃Ag/MC terdeteksi produk metanol dan formaldehida. Penambahan Ag pada katalis Ni₅Ga₃/MC meningkatkan konversi CO₂ dan yield produk metanol maupun formaldehida pada katalis Ni₅Ga₃Ag_{0,1}/MC. Yield optimum metanol dan formaldehida dihasilkan dengan rasio H₂/CO₂ 7/1 pada suhu 170 °C yaitu masing-masing 0,02 dan 2,26%.. Konversi CO₂ semakin kecil dengan semakin meningkatnya suhu reaksi karena kondisi reaksinya yang eksoterm.

.....The study of CO₂ hydrogenation reaction was carried out using bimetallic Ni-Ga and Ag-modified Ni-Ga catalysts supported on mesoporous carbon (MC). MC was successfully synthesized using the soft-template method by using phloroglucinol as a carbon precursor and pluronic F-127 as a template. The Ni-Ga and Ag-modified Ni-Ga catalysts were synthesized using the impregnation method with variations in Ag loading to give Ni₅Ga₃/MC, Ni₅Ga₃Ag_{0.1}/MC, Ni₅Ga₃Ag_{0.3}/MC, and Ni₅Ga₃Ag_{0.5}/MC catalyst. Based on the characterization of XRD, the formation of bimetallic Ni₅Ga₃ and Ag nanoparticles on MC have been confirmed. The EDX mapping image shows both Ni-Ga and NiGa-Ag were evenly distributed on the MC surface. BET-SAA analysis shows the pore diameter of Ni₅Ga₃/MC and Ni₅Ga₃Ag_{0.1}/MC catalysts are 5.5 nm and 6.0 nm respectively which are included in the mesoporous size of 2-50 nm. The activity of the catalyst in the hydrogenation reaction of CO₂ was carried out in a fixed-bed reactors. Both Ni₅Ga₃/MC and Ag-modified Ni₅Ga₃/MC catalysts gave methanol and formaldehyde as CO₂ hydrogenation products. The addition of Ag to the Ni₅Ga₃/MC catalyst increases the CO₂ conversion and yield of methanol and formaldehyde products. The highest yield of methanol of 0.02% and formaldehyde of 2.26% were obtained over Ni₅Ga₃Ag_{0.1}/MC catalyst with a H₂/CO₂ ratio of 7/1 at 170 °C. The conversion of CO₂ is getting smaller with increasing reaction temperature due to its exothermic reaction conditions.