Sintesis titanate nanotubes termodifikasi MoOx sebagai pendukung Katalis Cu untuk reaksi Methanol Steam Reforming = Synthesis of MoOx-Modified titanate nanotubes as support for Copper Catalyst in Methanol Steam Reforming reaction

Vannes, author

Abstrak

Untuk menjawab tantangan global terhadap persediaan sumber energi konvensional yang terus berkurang, energi hidrogen hadir sebagai kandidat sumber energi alternatif yang menjanjikan. Salah satu material cairan pembawa hidrogen adalah metanol. Melalui reaksi methanol steam reforming, metanol dapat direformasi membentuk hidrogen dengan rasio H/C yang tinggi pada suhu rendah. Pada penelitian ini, titanate nanotubes (TNTs) yang dimodifikasi dengan MoOx disintesis dengan metode hidrotermal dan presipitasi sebagai pendukung katalis Cu. Modifikasi bertujuan untuk memfasilitasi pembentukan karakteristik oxygen vacancy, yang dianggap menguntungkan reaksi water gas-shift dalam reaksi methanol steam reforming. Katalis berhasil disintesis dibuktikan dengan karakterisasi XRF, XRD, SAA-BET, Raman, dan TEM. Efek sinergis katalis terhadap reaksi methanol steam reforming dijelaskan dengan karakterisasi H2-TPR. Dari hasil uji aktivitas katalitik ditemukan katalis Cu@TNTs-MoOx 10% memberikan konversi metanol (~94,2%) dan produksi hidrogen (0,0043 mol/min/g) yang tinggi pada suhu optimal 400°C. Meskipun katalis ini selektif terhadap reaksi metanasi, tetapi menawarkan kestabilan termal, selektivitas CO yang rendah, dan meminimalkan pembentukan coke melalui pembentukan spesi MoOxCy.

......To address the global challenge of diminishing conventional energy supplies, hydrogen energy has emerged as a promising candidate for alternative energy sources. One of the liquid hydrogen carriers is methanol, which can be reformed to produce hydrogen with a high H/C ratio at low temperatures through the methanol steam reforming reaction. In this study, titanate nanotubes (TNTs) modified with MoOx were synthesized via hydrothermal and precipitation methods as a support for copper catalysts. This modification aims to facilitate the formation of oxygen vacancy characteristics, which are considered beneficial for the water-gas shift reaction during methanol steam reforming. The catalysts were successfully synthesized, as confirmed by XRF, XRD, SAA-BET, Raman, and TEM characterizations. The synergistic effects of the catalysts on the methanol steam reforming reaction were analyzed using H2-TPR characterization. Catalytic activity tests revealed that the Cu@TNTs-MoOx 10% catalyst achieved high methanol conversion (~94.2%) and hydrogen production (0.0043 mol/min/g) at an optimal temperature of 400°C. Although this catalyst is selective toward methanation reactions, it offers thermal stability, low CO selectivity, and minimizes coke formation through the generation of MoOxCy species.