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Hydrodesulfurization of model diesel using Pt/Al_2O_3 catalysts prepared by supercritical deposition

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Abstract

Pt/Al_2O_3 catalysts with Pt loadings ranging from 0.5 to 11 wt.% were synthesized by supercritical carbon dioxide ($scCO_2$) deposition method. Transmission electron microscopy (TEM) images showed that the synthesized catalysts contained small Pt nanoparticles (1–4 nm in diameter) with a narrow size distribution, no observable agglomeration, and uniformly dispersed on the alumina support. The catalysts were found to be active for hydrodesulfurization of dibenzothiophene (DBT) dissolved in *n*-hexadecane (*n*-HD) without sulfiding the metal phase. The reaction proceeded only via the direct hydrogenolysis route in the temperature range 310–400 °C and at atmospheric pressure. The activity increased with increasing the metal loading. Increasing $[H_2]_0/[DBT]_0$ by either increasing $[H_2]_0$ or decreasing $[DBT]_0$, increased the DBT conversion. At a fixed weight hourly space velocity and feed concentration, conversion did not increase with increasing temperature beyond 330 °C. The presence of toluene inhibited the catalyst activity presumably due to competitive adsorption between DBT and toluene. Under the operating conditions, the reaction was far from equilibrium.

Keywords: Hydrodesulfurization; Supercritical deposition; Diesel; Fuel cell