Characterization of Palladium (Pd) on Alumina Catalysts Prepared Using Liquid Carbon Dioxide

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Supported palladium (Pd) catalysts were prepared using an environmentally benign route. Palladium (II) hexafluoroacetylacetonate ($Pd(hfac)_2$) dissolved in liquid carbon dioxide ($L-CO_2$) was used to deposit Pd nanoparticles onto low-surface-area α-alumina (13.3 m^2/g) and high-surface area γ-alumina (207.0 m^2/g) supports. $Pd(hfac)_2$ dissolved in $L-CO_2$ at 6.9 MPa and 28.5 °C was impregnated into the supports by slowly venting gaseous CO_2 until $L-CO_2$ was completely evaporated. After depressurization, the impregnated $Pd(hfac)_2$ was reduced in hydrogen at a relatively low temperature of 75 °C. The adsorption isotherm of $Pd(hfac)_2$ on γ-alumina suggests a weak interaction between the organometallic compound and the support. The average particle size on the low-surface-area α-alumina increased from 13.1±3.5 to 59.9±11.3 nm and the metal dispersion, measured by pulsed CO chemisorption, decreased from 11% to 3% as the Pd loading increased from 0.15 to 1.54 wt%. When high-surface-area γ-alumina was used, Pd particle size increased from 3.1±1.9 to 7.0±5.9 nm and metal dispersion decreased from 56 to 5 % as Pd loading increased from 0.58 to 3.94 wt%.