Bimetallic Pt-Pd/silica-alumina hydrotreating catalysts. Part II: Structure-activity correlations in the hydrogenation of tetralin in the presence of dibenzothiophene and quinoline

Abstract:
The catalytic hydrogenation of tetralin in the absence and presence of quinoline and dibenzothiophene was studied on bimetallic Pt-Pd catalysts supported on silica and amorphous silica-alumina (ASA). The proportion of Pt on the surface determined the activity given that the Pt-Pd catalyst with the highest proportion of surface Pt was the most active. In the absence of poisons, the electronegativity of the support correlated with the hydrogenation. In the presence of quinoline, the activity of the catalysts increased with the dispersion of the metal particles, whereas in the presence of dibenzothiophene, the acidity of the support controlled the activity. The observed effects of the poisons indicated the presence of two kinds of adsorption sites, that is, metal particles and Bronsted acid sites at the perimeter. The key contribution of acid sites for hydrogenation was confirmed by removing the Bronsted acid sites of the support. Reference Pt catalysts were more active than the Pt-Pd counterparts in poison-free feed. In the presence of poisons, the Pt catalysts were also more active than the bimetallic formulations with the remarkable exception of the bimetallic catalyst with the higher proportion of Pt on the surface. The bimetallic catalysts are more resistant to sulfur and nitrogen poisoning as
well as to sintering. The poison resistance of bimetallic catalysts originates from the electron transference from Pt to Pd that yields weak adsorption of poisons on electron deficient Pt atoms. However, the surface coverage of Pt must be maximized to compensate the low activity of Pd-enriched catalysts. (C) 2012 Published by Elsevier Inc.