

Improvement of diesel quality over niobia-supported iridium catalysts

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Palavras Chave: *improved diesel, niobia, iridium catalyst*.

Abstract

Niobia-supported iridium catalysts are promising for improving diesel quality, the selectivity depending on the acidity.

Introdução

Because of increasing strictness of environmental legislation, high quality fuels are ever more required. It is well known that the diesel quality can be largely improved by selective opening of naphthenic rings through the endocyclic cleavage of C–C bonds. The process provides the replacement of aromatics by non-toxic compounds with higher cetane number, decreasing particulate emission¹. The most promising catalysts for this reaction are based on iridium. However, they are not enough selective, requiring new or modified catalysts. For this purpose, niobia-supported iridium catalysts were studied in this work. Samples were prepared by impregnation of niobia, previously obtained by calcining niobium pentoxide hydrate (HY-340, CBMM) at 250, 350 and 450 °C, for 3 h. The supports were dispersed in hexachloroiridic acid hexahydrate solutions, to obtain solids with 0.5 % of iridium. The solids were characterized by X-ray diffraction, specific surface area (Sg) measurements, temperature programmed reduction (TPR), temperature programmed desorption of ammonia (NH₃-TPD) and cyclohexane dehydrogenation, a model reaction for metal sites. The catalysts were evaluated in the selective opening of decalin, a model reaction for metal sites.

found, assigned to the reduction of iridium oxide in different interactions with the support. Iridium made the support reduction more difficult for all samples. The catalysts were active in selective opening of decalin, as shown in Table 1. The IN-350 led to the highest conversion (36%) and was the most selective to ring opening products (RO). This improved performance can be related to the suitable ratio of moderate and weak acid sites favoring the ring selective opening through a bifunctional mechanism but avoiding cracking reactions. As shown by cyclohexane dehydrogenation, this sample led to the lowest value of cyclohexane conversion, indicating that it has the lowest amount of iridium on the surface. Because of this, it was the least selective to the undesirable products of dehydrogenation (D), such as naphthenics (Table 1).

Table 1. Specific surface areas (Sg), acidity (A), cyclohexane conversion (X_{CH}), decalin conversion (X_D) and selectivity to cracking (C), ring opening (RO) and dehydrogenation (D).

Samples	Sg (m ² g ⁻¹)	A x 10 ⁴ (mol.g ⁻¹)	X _{CH} (%)	X _D (%)	Selectivity (%)		
					C	RO	D
IN-250	90	5.15	25	29	12	40	32
IN-350	80	3.87	18	36	9.2	51	23
IN-450	24	1.76	26	26	8.8	15	58

Resultados e Discussão

The specific surface areas of the supports did not change with calcination temperature (120, 117 e 105 m² g⁻¹) but decreased due to iridium impregnation. As shown in Table 1, the values also decreased with increasing calcination temperature. The acidity of the catalysts (mol_{NH₃}. g⁻¹_{cat}) followed the same tendency. The sample calcined at 250 °C showed weak and moderate acid sites. However, the acid strength decreased with increasing temperature and the IN-450 sample showed only low amounts of moderate sites. In TPR curves, peaks at 168 and 370 °C were

Conclusões

The niobia-supported iridium calcined at 350 °C was the most efficient catalyst to improve diesel quality by the ring selective opening of naphthenics. This was related to its suitable acid and metal properties.

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