ISGC 2022

N°70 / OC
TOPIC(s) : Industrial chemistry / Homogenous, heterogenous and biocatalysis

Efficient hydrogenation of aliphatic amides to amines over heterogeneous catalysts

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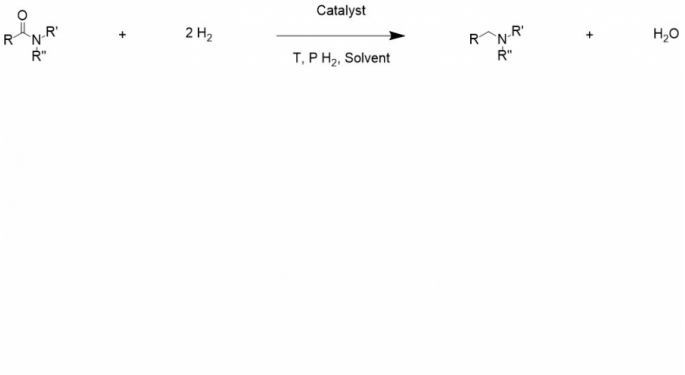
PURPOSE OF THE ABSTRACT

The selective catalytic reduction of amides using molecular hydrogen is an attractive synthesis route for the green and sustainable production of amines at industrial scale. The hydrogenation reaction is an atom efficient and environmentally benign process as water is the only by-product generated. In addition, the heterogeneous catalyst can be recycled and reused. The amide can be obtained from renewable sources making the target product bio-based amine. The resulting amines are widely used in the industry for the production of pharmaceuticals, agrochemicals, surfactants, dyes and polymers. In this work, a highly efficient catalytic hydrogenation system was developed for the selective transformation of aliphatic amides to the corresponding amines at relatively mild reaction conditions (Scheme 1).

Industrial hydrogenation catalysts such as Pd/Al2O3, Pt/Al2O3 and Rh/Al2O3 were modified with vanadium (V) or molybdenum (Mo) species as oxophilic centers. The modified catalysts were prepared by deposition of V or Mo precursor on supported catalysts via impregnation method. The catalysts were characterized by several techniques, such as, ICP-OES, XRD, XPS, H2-TPR, FTIR, CO-chemisorption, TEM, SEM-EDX and TGA. Modified Rh-V/Al2O3 catalyst displayed the best performance affording high yield and selectivity > 95 % to the desired tertiary and secondary amines at moderate reaction conditions of T < 130 °C and P H2 < 50 bar (Figure 1).

The strong synergistic interaction and proximity of hydrogenation Rh0 sites and oxophilic V?+ sites in the bimetallic Rh-V/Al2O3 catalyst were determined to be beneficial for the selective dissociation of C=O bond of the carboxamides into the desired amines.

FIGURES



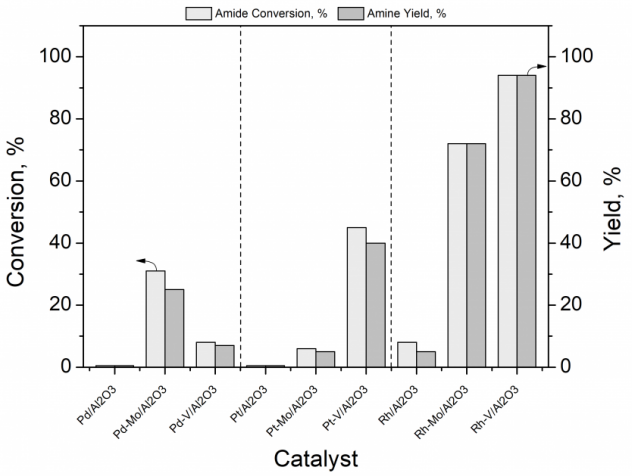


FIGURE 1

Scheme 1

Selective hydrogenation of aliphatic amides to amines over heterogeneous catalyst.

FIGURE 2

Figure 1

Catalyst screening in hydrogenation of aliphatic amide to amine.

KEYWORDS

Hydrogenation | Amide | Amine | Catalyst

BIBLIOGRAPHY

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