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Catalytic hydrogenation for technological applications and environmental protection

Abstract

Catalytic hydrogenation is one of the most essential processes for modern civilization. It is used in multiple manufacturing operations but also in environmental protection. The presented studies concern the application of catalytic hydrogenation in water purification from one of the most frequently detected chloroorganic contaminants (trichloroethylene and diclofenac) and in the selective transformation of nitrocyclohexane. The conducted research follows the international trend of increasing the economic efficiency of applied catalysts and making catalytic processes more environmentally friendly.

The general goal of the presented research was to develop efficient and stable catalysts for both hydrogenation processes. The consecutive chapters in this doctoral dissertation present the catalysts developing process, including modification of their morphology, as well as optimization of catalytic performance at various conditions in batch and flow reactors.

The application of various synthesis methods (incipient wetness impregnation, wet impregnation, ion-exchange, nanoparticles grafting, co-precipitation) in combination with alteration of pretreatment conditions allowed obtaining catalysts with extraordinary performance:

- 2 wt.% Ni(Cl)/CNR115/2173/26.54, which allowed for water purification from trichloroethylene for 25 h without any signs of deactivation,
- 2 wt.% Pd/SiO_2(bim), which allowed for water purification from diclofenac for 15 h without any signs of deactivation,
- a series of CuZnAl hydrotalcite derived materials, which selectively hydrogenate nitrocyclohexane into various value-added products under mild conditions.

A thorough analysis of catalysts structures by numerous characterization techniques allowed drawing general conclusions concerning the impact of catalyst morphology on its activity, selectivity and stability in tested conditions.