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Abstract

Preparation of pharmaceutical intermediates by flow catalytic hydrogenation processes

Current methods of producing vitamins and pharmaceuticals mainly rely on stoichiometric reagent amounts. As a result, the final products are usually expensive and generate much waste. The high prices of drugs and vitamins lead to limited access to them, especially in poor developing countries, and the production of tons of waste has a negative impact on the environment. Consequently, it is necessary to develop alternatives, including a change from reactions carried out in batch reactors to flow reactions and from stoichiometric to catalytic processes. In this regard, in the era of sustainable development, it is crucial to expand research focused on developing low-cost, environmentally safe, well-characterized, and efficient catalytic systems for obtaining high-quality products. Examining the complex technological processes of drug and vitamin synthesis, at least one step is hydrogenation. Therefore, in the scope of the dissertation, catalysts were synthesized and comprehensively characterized by physicochemical methods, with different metal loading (2 wt.% - 14 wt.%), based on palladium and low-cost transition metals (Co Cu, Fe) and supported on activated carbon, or grafted on TentaGel™ S-NH_2 polymer resin or included in the composition of hydrotalcite materials. The obtained catalysts showed high activity, stability, and high selectivity to the desired products in selective hydrogenation reactions:

- 2-methylbut-3-yn-2-ol to 2-methylbut-3-en-2-ol, which is a precursor to in the synthesis of vitamin A and E;
- But-2-yne-1,4-diol to but-2-ene-1,4-diol used in the synthesis of nylon, resins or vitamins A and B6;

and also chemoselective hydrogenation:

- 2-methylpent-2-enal to 2-methylpentanal, which enables the production of meprobamate - an anxiolytic drug, as well as various dyes and resins.

The obtained results allowed examine correlations between the structure of the studied systems and their reactivity in selective catalytic hydrogenation reactions in flow conditions, as well as determine the optimal pressure and temperature conditions for a given catalytic reaction.

In conclusion, this dissertation provides important information related to the selective catalytic hydrogenation reaction of unsaturated organic compounds in flow conditions. The finding obtained in the Ph.D. thesis provides a basis for the design of efficient, low-cost, more versatile, and environmentally friendly catalysts of importance in the pharmaceutical industry.