

## ABSTRACT

The purpose of the presented doctoral dissertation was design of novel chiral homogeneous catalysts based on chiral vanadium(V) and molybdenum(VI) tridentate and tetradentate Schiff base complexes, monocondensation products of salicylaldehyde and its derivatives with optically active amino acids and amino alcohols, and moreover sugar-based chiral Schiff bases. Some of these complexes have been heterogenized by the reactions of encapsulation in zeolite-Y nanocavities. Another important objective was to examine their catalytic activity in asymmetric oxidation of prochiral simple sulfides and the oxidation of organic alkenes and monoterpenes, after optimization of reaction conditions and the determination of the efficiency, selectivity and enantiomeric excesses of the products. The main goal of heterogenization of chiral homogeneous catalysts is to combine the positive aspects of a homogeneous catalyst (*e.g.* high activity and enantioselectivity or good reproducibility) with those of a heterogeneous catalyst (*e.g.* ease of separation, stability and reusability).

Homogeneous catalysts have been also characterized by elemental analysis and different spectroscopic techniques, *e.g.* IR, UV-Vis and CD, but also by 1D NMR ( $^1\text{H}$ ,  $^{13}\text{C}$ ,  $^{51}\text{V}$ ) and 2D NMR (COSY, HSQC, NOESY) techniques and single-crystal X-ray diffraction. After heterogenization of selected homogeneous vanadium(V) catalysts, their characterization has been carried out by thermogravimetric analysis, powder X-ray diffraction method and EPR spectroscopy. Furthermore, porous material of the heterogeneous catalysts has been also studied by BET method to determine specific surface area and its pore sizes, and their surface images were made by scanning electron microscopy (SEM).

Optically active vanadium(V) and molybdenum(V) Schiff base complexes and chiral sugar-based Schiff bases in the presence of  $\text{VO}(\text{acac})_2$  or  $\text{MoO}_2(\text{acac})_2$ , have been used to study their catalytic activity in the asymmetric oxidation process of simple prochiral sulfides to the corresponding sulfoxides and oxidation of alkenes, *e.g.* styrene and cyclohexene, but also monoterpenes by 30% hydrogen peroxide or *tert*-butyl hydroperoxide (TBHP) as the terminal oxidant.