Summary of the Doctoral Thesis

Title: New unalloyed metal nanoconjugates as catalysts in selected reduction or acetalization reactions for green chemistry

Author: Weronika Ambrożkiewicz

Supervisor: Prof. dr hab. inż. Jarosław Polański

New nano–catalysts were design and studied for unalloyed metals synergies. These materials were tested as potential catalysts for selected reduction or acetalization reactions which are great importance in environmental chemistry.

A series of mono, bi and tri-metal nanocatalytic transition metal systems were obtained and investigated. The catalysts included combinations of metals (Re, Ru, Rh, Ir, Pd) deposited on a silica support (SiO_2) or on a metal support (Ni or Mo). These are new, never described before, catalytic nanomaterials. The studied nanocatalytic systems may be reproducibly obtained by the described synthetic methods. These heterogeneous nanocatalysts can be used in industrial processes, especially in the reaction of carbon dioxide methanation, ammonia decomposition and glycerol acetalization.

In the low–temperature ammonia decomposition reaction, a high activity was obtained by the Pd_{NPs}/Ni catalyst which can be used to generate hydrogen in fuel cells. The Ru_{NPs}/Ni catalyst has a high activity in the reaction for low–temperature methanation of carbon oxides and can be used in methane production which is a renewable energy source beside reducing CO_2 emissions. Obtained nanocatalysts: Re/SiO_2, ReRu/SiO_2, ReIr/SiO_2, ReRuIr/SiO_2, ReRhIr//SiO_2, ReRuRh/SiO_2, RuRhIr/SiO_2, Ru/Mo, RuRh/Mo, RuRhIr/Mo and ReRhIr/Mo show high activity in acetalization reactions. Nano-Re supported on nano-SiO_2 is a highly active and selective catalyst for the acetalization of glycerol into five-membered cyclic acetals (e.g., solketal) and can be used for the processing of glycerol waste. In all tested catalytic systems, synergistic effects were observed between the individual components of the catalysts. The tested catalytic systems may have practical application and serve for the development of the described industrial chemical processes, which may bring ecological and economic benefits.