

NEW APPROACH TO PREPARE HIGHLY DISPERSED NON-NOBLE (BI)METALLIC NANOPARTICLES SUPPORTED ON ORDERED MESOPOROUS SILICAS FOR CATALYTIC APPLICATIONS

Research project PN-II-ID-PCE-2011-3-0868 financed by the UEFISCSU Romania

Non-noble (bi)metallic supported nanoparticles (NPs) (e.g. Ni, Cu and Co-based) offer a range of technical and commercial advantages, which makes them a feasible alternative to the more expensive supported noble metal NPs (e.g. Pt, Pd, Ir, Au) catalysts. Consequently, over the last decade, an extensive research focused on the preparation methods and/or applications of (bi)metallic supported NPs as catalysts in various (de)hydrogenation processes involved in important fields such as fine chemistry, environmental pollution control, energy and so on.

The unique properties of supported NPs are directly related to the specific particle morphology (size and shape), metal dispersion, concentration and the electronic properties of the metal within their host environment. Therefore, as compared to their bulk counterparts, greatly enhanced catalytic performances of the supported NPs (i.e., activities and selectivities) have been reported, which was explained by larger surface-to-volume ratios of NPs (i.e. higher dispersions) associated with an increased number of defect sites, kinks, steps, edges and corners. Furthermore, as compared with the monometallic counterparts, supported bimetallic NPs have proven to exhibit much improved catalytic performances, due to changes in the geometric and/or electronic properties of the main metal in bimetallic NPs, which are induced by the addition of the second metal (i.e., by ensemble and/or electronic effects).

We propose a new convenient approach to prepare highly dispersed and highly thermostable non-noble (bi) metallic NPs supported on ordered mesoporous silica for applications in heterogeneous

catalysis, more specifically in the liquid phase chemoselective hydrogenation of unsaturated aldehydes (e.g., cinnamaldehyde). Such remarkable properties can be achieved by controlled stabilization of precursor species during the drying step prior to calcination. The project proposal outlines a research programme aimed to gain insight into the mechanism of stabilization of NPs within the dual pore system of SBA-15 materials offering scientific bases to develop a general method of preparing metal nanocatalysts supported on mesoporous silicas.

The project opens-up new opportunities in the field of catalysis based on nanotechnology approaches pursuing the industrial applications and development of technologies. Since about 80% of the processes in the chemical industry depend on catalysts to work efficiently, a new understanding and mastery of broad spectra of supported NPs-based catalysts could have also high societal impacts. Therefore, it is anticipated that findings and conclusions of this project will be of high significance for scientists having interests in areas such as materials science, catalysis etc. The proposal also aims to the training of students and young researchers to implement in Romania the materials and catalysis advances.

Principal Investigator

Prof. Emil Dumitriu, Ph.D.

Faculty of Chemical Engineering and Environmental

Protection

“Gheorghe Asachi” Technical University of Iasi, Romania

edumitri@tuiasi.ro