17252/5004-2A

Institute of Physical Chemistry
Polish Academy of Sciences

Juan Carlos Colmenares Quintero, Ph.D. D.Sc.
Associate Professor
Research group leader
"Catalysis for sustainable energy production and environmental protection, CatSEE"

Kasprzaka 44/52, PL-01 224 Warsaw, Poland
Tel.: +48 22 343 3215
Fax: +48 22 343 3448
jcarloscolmenares@ichf.edu.pl
http://photo-catalysis.org/

Evaluation of the habilitation thesis entitled: "**Synthesis of Advanced Nanomaterials: Catalytic and Sustainable Applications"** by Manoj B. Gawande, Ph.D.

Nowdays, nanocatalysis is one of the fast growing fields, which practically covers the use of nanomaterials as catalysts for a variety of important catalytic transformations. Heterogeneous catalysis means one of the most important commercial applications of nanoscience: nanoparticles (NPs) of metals, semiconductors, oxides, and other compounds have been broadly used for key catalytic reactions. Due to the fact that most commercial catalysts are still fabricated by ordinary and conventional mixtures of multicomponents, their nanoscale characteristics and structures are not well controlled and the synthesis–characterization–catalysis interactions are not-well understood.

The use of metal, metal oxides, and mixed metal oxides NPs in catalysis is critical as they mimic active metal surface at the nanoscale and thereby giving selectivity and efficacy to heterogeneous catalysis. Tuning the properties of nanocatalysts helps us in the exploration of NPs characteristics such as crystalline structure, morphology and composition applying different synthetic methodologies. To understand the properties of the nanocatalysts, it is imperative to explore and clarify the chemical and physical properties of such materials, which cover the shape and size of the nanoparticles, surface properties, and nature of surface active sites.

In this habilitation thesis, Dr. Gawande emphasizes sustainable organic transformations catalyzed by earth-abundant iron-based catalysts, supported catalysts and core-shell nanocatalysts. Dr. Gawande is focusing on identifying the driving forces for the design and synthesis of specific nanocatalysts, the specific mechanistic knowledge on the desired reaction that defines the requirements from nanotechnology in the fabrication of the expected catalysts. In this habilitation thesis, I can observe a real synergy between nanotechnology and fundamental mechanistic studies, supported by the knowledge from surface nanoengineering science and theoretical calculations/simulations for the fabrication of efficient and sustainable nanocatalysts.

Twenty one (21) publications in well-recognized scientific journals and with a summary impact factor of 175.4 are the strong base of this outstanding habilitation thesis. The thesis is divided in two logically and well-organized parts, namely:

1. Thesis-PART-1- Introduction and Results: with 71 pages and composed of five (5) sub-sections: Introduction, Iron-oxide-based Catalysts, Core-shell Nanoparticles – Applications in Catalysis, Sustainable Organic Transformations, References (228 in total).
2. Thesis-PART-2-Apendices: with 183 pages and 18 appendices which are related to the habilitation's publications.

As far as the "Thesis-PART-1" is concerned, Dr. Gawande did a tremendous excellent scientific work which convinced me that magnetic iron-based and core-shell-based nanocatalyts are worth of investigation and with promising perspective for application in the