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ABSTRACT

The habilitation thesis with the title "***Heteronanostructures based on metal oxides and gold nanoparticles: opportunities and challenges***" represents my professional and scientific contribution corresponding to the period after the doctoral internship. I obtained the scientific title of doctor in 2010 at the University of Bucharest with the thesis *"Complex combinations with thioligands"* in the field of Chemistry.

The habilitation thesis addresses a current and necessary topic in the field of Environmental Engineering.

The thesis is structured in three parts: the first part represents a brief presentation of the didactic and research activity. The second part is dedicated to personal scientific achievements in the field of photocatalysis based on complex systems. Within this section, the following were proposed and investigated:

- Heterostructures based on TiO2 doped with Au and RuO_2 nanoparticles
- Au/TiO_2 - C_3N_4 and Bi_2O_3 – P/C_3N_4 type Z-scheme schemes
- Various morphologies based on TiO_2: nanosheets, nanobels, nanorods
- Au nanoparticles: synthesis and applications

In photocatalysis, it is very important to obtain efficient, cheap, non-toxic, non-polluting complex systems that make possible the access of visible light in the photocatalysis process. The sun is an inexhaustible source of energy, the use of this resource is a desire of scientists. In this sense, the aim was to reduce the band gap and separate the charge carriers so that the access of visible light to the photocatalysis process is possible. The influence of the architecture of TiO_2 structures on future wing arrays was investigated: Morpho Dididus, Butterfly Ambasador Peacock Butterfly etc. TiO_2 nanostructures of different shapes and sizes were synthesized: nanobels, nanorods,

nanosheets, each type of structure having special properties. Several synthesis techniques were addressed: sol-gel, hydrothermal and in the microwave field. For the most effective separation of charge carriers, the TiO_2 nanostructures were doped with Au and RuO_2. Another approach was the construction of Z-scheme systems such as $Au/TiO_2/C_3N_4$ and Bi_2O_3/C_3N_4 with excellent performance in the mineralization of organic compounds. The gold nanoparticles used to decorate TiO_2-based nanostructures were synthesized by a proprietary method by reducing Au^+ with a Schiff base. The synthesized heterostructures were characterized by UV-Vis, IR, XPS, Raman, structural and morphological spectroscopy by XRD, FE-SEM, EDS and TEM. The evaluation of the catalytic performance of the heterostructures was carried out on standard molecules of Methyl Blue, Rhodamine B, Ibuprofen, Naproxen under visible light.

The third part presents the professional, scientific and academic career development with the main research directions. The research will be oriented in the directions in which we have achieved results and acquired expertise plus addressing new future research directions:

- Synthesis of Z-scheme and S-scheme complex photocatalytic systems based on $Au@TiO_2/WO_3/C_3N_4$ for environmental depollution.
- Synthesis of complex systems for the photocatalytic conversion of biomass

The summary of the scientific research activity is realized through the publication of 39 ISI articles (of which 3 before the defense of the doctoral thesis), 15 articles as main author, 11 research contracts (2 contracts as director) over 20 participations in international conferences.