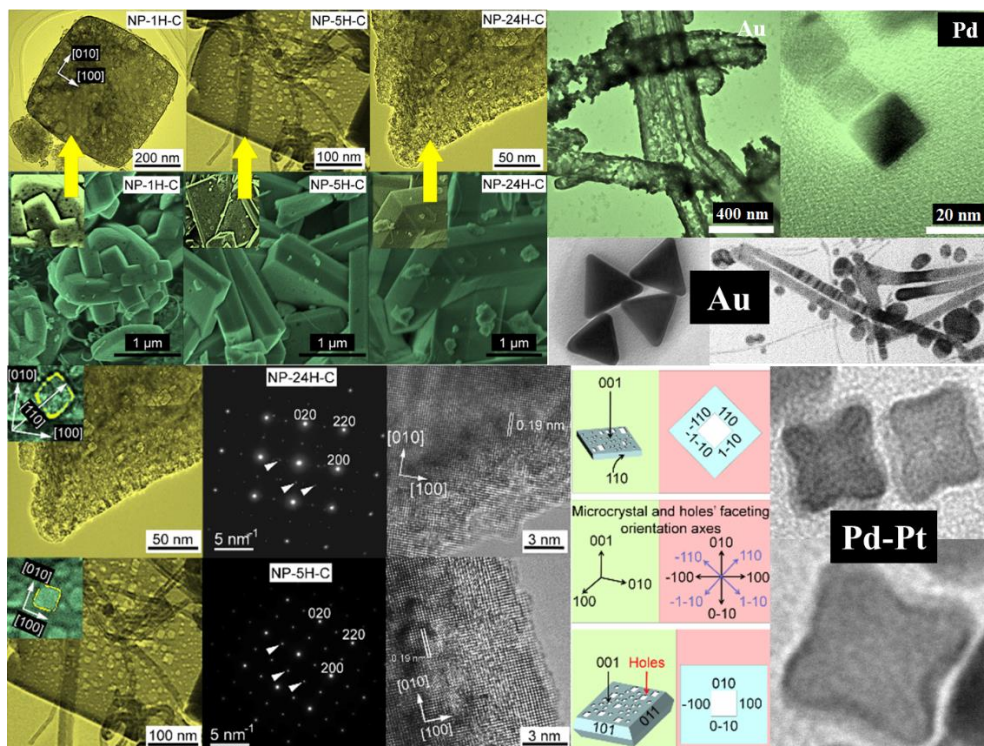


LABORATORY FOR THE STUDY OF MATERIALS USED IN PHOTOCATALYTIC APPLICATIONS

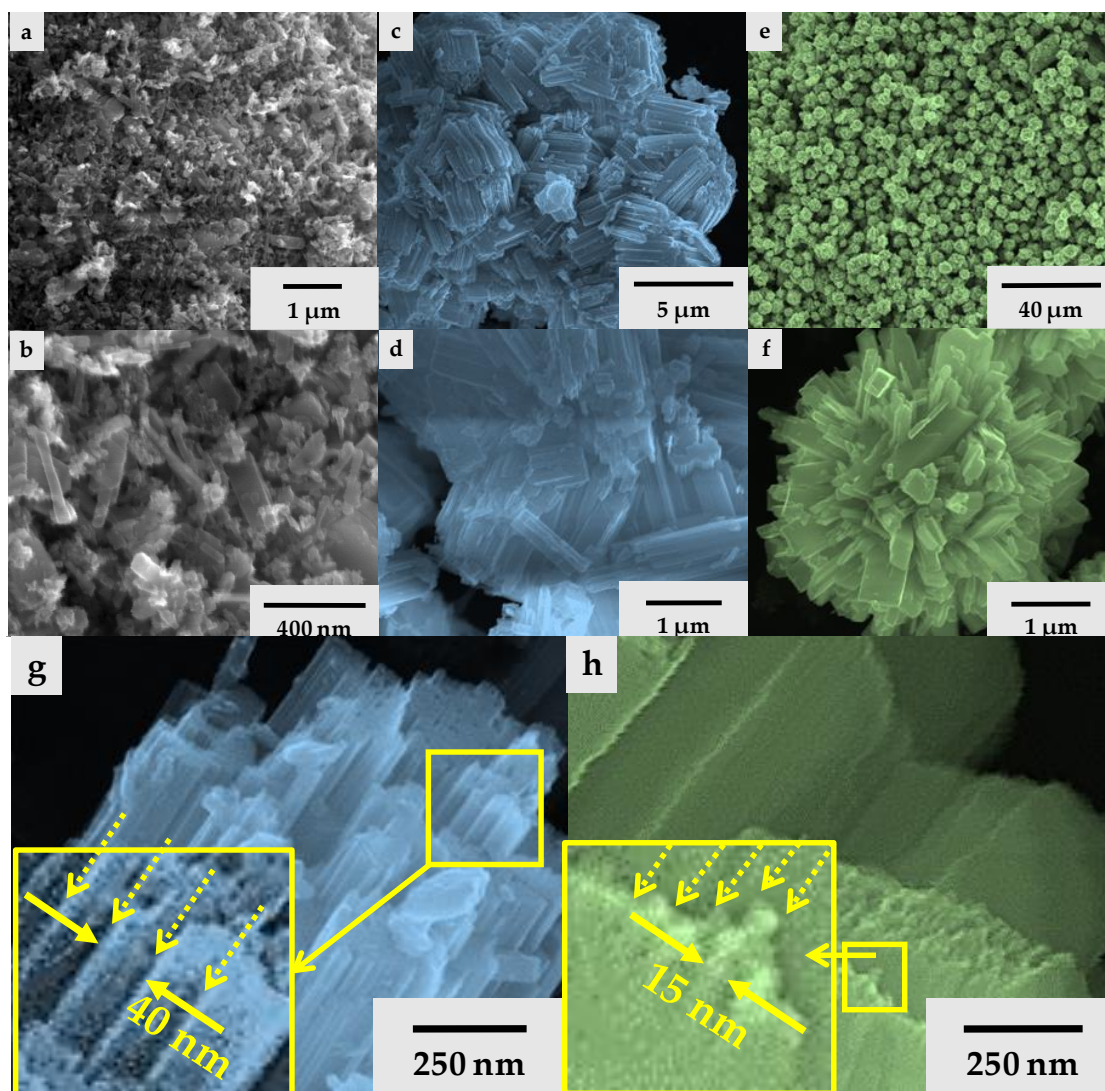
ABOUT US

The researches performed in this laboratory are focused on the development of photocatalytic materials with high activity in the degradation of organic pollutants and hydrogen production. The scientific work is directed towards the synthesis of composite materials, the assessment of the pollutant photodegradation rate constants (by means of UV-vis spectroscopy) and the preliminary evaluation of the composites from the perspective of their optical properties (Eg determination and crystalline phase identification by means of Diffuse Reflectance Spectroscopy (DRS)). The most frequently used semiconductors are TiO_2 , WO_3 and Bi_2WO_6 . Additionally, some other charge separator materials, such as noble metals (Pt, Pd and Au) were also introduced in the composite systems. A few examples of our recent studies/results are inserted below.

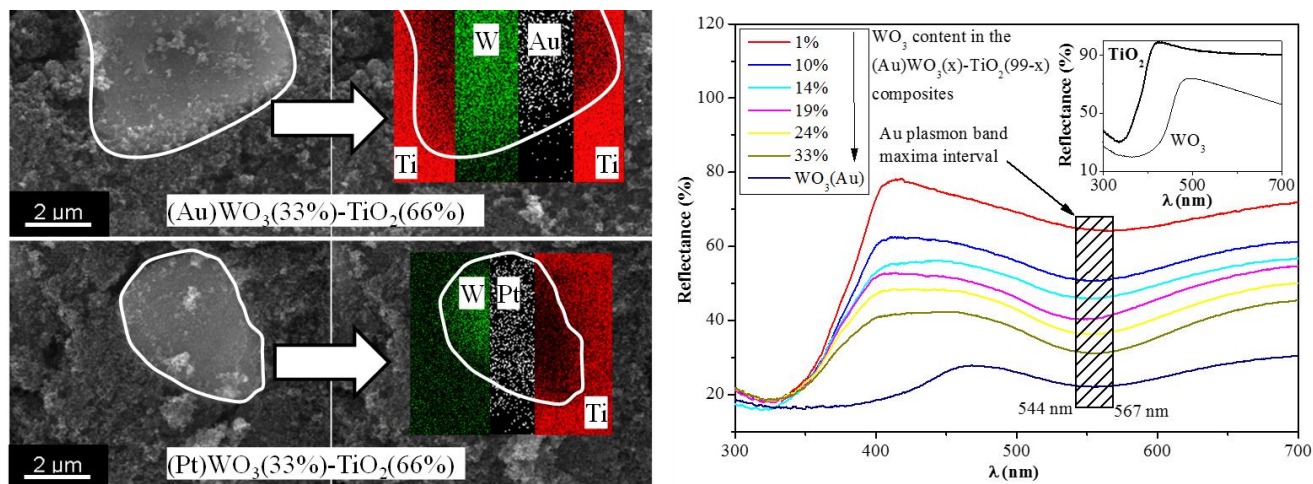
Shape tailored titania (left) and noble metals (right) nanostructures for photocatalytic applications



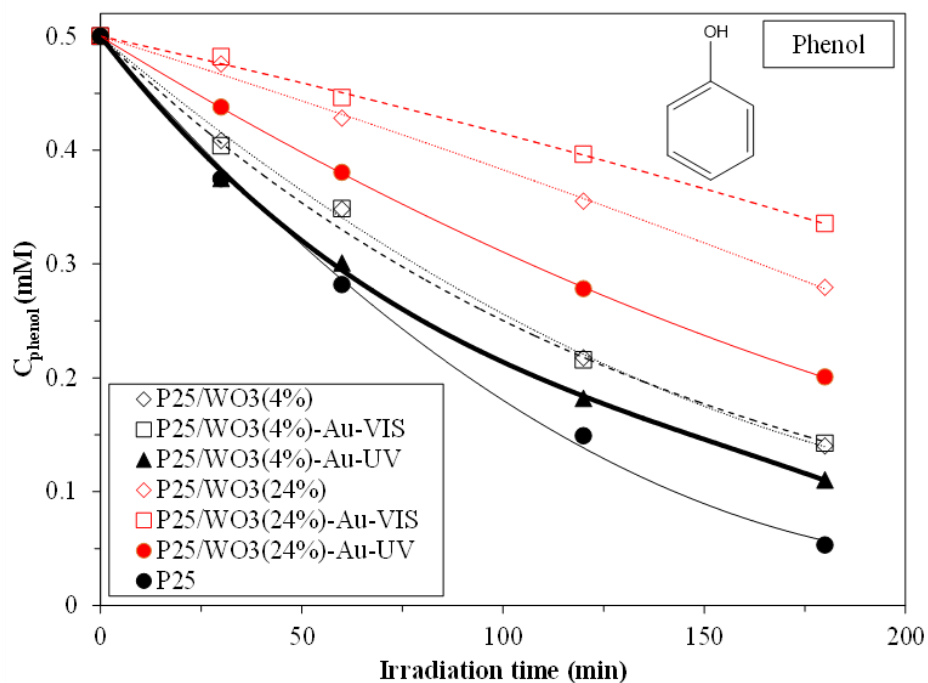
Shape tailored WO₃ nanocrystals for photocatalytic applications



Successful selective photodeposition of noble metal nanoparticles on the TiO_2 and WO_3 surfaces (left) and the composite assessment by DRS measurements (right)



The photocatalytic performance of TiO_2/WO_3 -Au composites



Research GROUP

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Master stud. Zoltán KOVÁCS

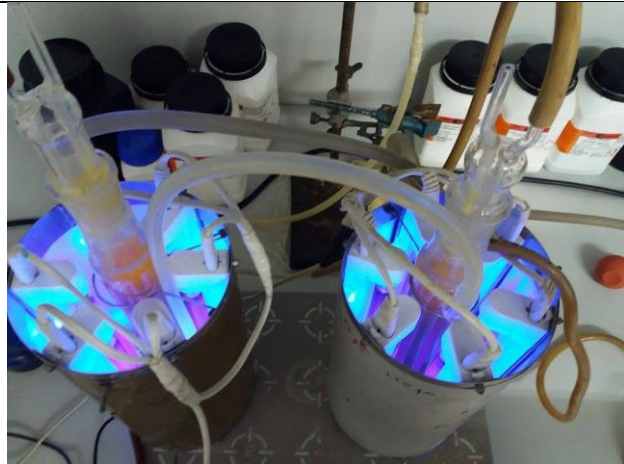


INFRASTRUCTURE

**Jasco-v650 spectrophotometer
coupled with an integrated
sphere (ILV-724)**



**Photoreactor system (UV and
visible light)**



**Tousimis critical point dryer
Samdri®-PVT-3D (for
supercritical drying)**



Autoclave (for hydrothermal method)



Centrifuge EBA 21



SELECTED PAPERS

Baia, L., Orbán, E., Fodor, S., Hampel, B., Kedves, E.Z., Saszet, K., Székely, I., Karácsonyi, É., Réti, B., Berki, P., Vulpoi, A., Magyar, K., Csavdári, A., Bolla, C., Coşoveanu, V., Hernádi, K., Baia, M., Dombi, A., Danciu, V., Kovács, G., Pap, Z., *Preparation of TiO₂/WO₃ composite photocatalysts by the adjustment of the semiconductors' surface charge*, (2016) *Materials Science in Semiconductor Processing*, **42**, 66-71.

Székely, I., Kovács, G., Baia, L., Danciu, V., Pap, Z., *Synthesis of shape-tailored WO_3 micro-/nanocrystals and the photocatalytic activity of WO_3/TiO_2 composites*, (2016) *Materials*, **9** (4), art. no. 258.

Vajda, K., Saszet, K., Kedves, E.Zs., Kása, Zs., Danciu, V., Baia, L., Magyari, K., Hernádi, K., Kovács, G., Pap, Zs., *Shape-controlled agglomeration of TiO_2 nanoparticles. New insights on polycrystallinity vs. single crystals in photocatalysis*, (2016) *Ceramics International*, **42** (2), 3077-3087.

Kovács, G., Fodor, S., Vulpoi, A., Schrantz, K., Dombi, A., Hernádi, K., Danciu, V., Pap, Z., Baia, L., *Polyhedral Pt vs. spherical Pt nanoparticles on commercial titanias: Is shape tailoring a guarantee of achieving high activity?*, (2015) *Journal of Catalysis*, **325**, 156-167.

Vajda, K., Kása, Z., Dombi, A., Németh, Z., Kovács, G., Danciu, V., Radu, T., Ghica, C., Baia, L., Hernádi, K., Pap, Z., *"crystallographic" holes: New insights for a beneficial structural feature for photocatalytic applications*, (2015) *Nanoscale*, **7** (13), 5776-5786.

Pap, Z., Tóth, Z.R., Danciu, V., Baia, L., Kovács, G., *Differently shaped Au nanoparticles: A case study on the enhancement of the photocatalytic activity of commercial TiO_2* , (2015) *Materials*, **8** (1), 162-180.

Baia, L., Vulpoi, A., Radu, T., Karácsonyi, T., Dombi, A., Hernádi, K., Danciu, V., Simon, S., Norén, K., Canton, S.E., Kovács, G., Pap, Z., *$\text{TiO}_2/\text{WO}_3/\text{Au}$ nanoarchitectures' photocatalytic activity "from degradation intermediates to catalysts' structural peculiarities" Part II: Aerogel based composites - fine details by spectroscopic means*, (2014) *Applied Catalysis B: Environmental*, **148-149**, 589-600.

Puskelova, J., Baia, L., Vulpoi, A., Baia, M., Antoniadou, M., Dracopoulos, V., Stathatos, E., Gabor, K., Pap, Z., Danciu, V., Lianos, P., *Photocatalytic hydrogen production using $\text{TiO}_2\text{-Pt}$ aerogels*, (2014) *Chemical Engineering Journal*, **242**, 96-101.

Kovács, G., Baia, L., Vulpoi, A., Radu, T., Karácsonyi, T., Dombi, A., Hernádi, K., Danciu, V., Simon, S., Pap, Z., *$\text{TiO}_2/\text{WO}_3/\text{Au}$ nanoarchitectures' photocatalytic activity, "from degradation intermediates to catalysts' structural peculiarities", Part I: Aeroxide P25 based composites*, (2014) *Applied Catalysis B: Environmental*, **147**, 508-517.

RESEARCH PROJECTS

INTERNATIONAL RESEARCH PROJECTS:

COST 540 project - **Photocatalytic technologies and novel nanosurfaces materials-critical issues –PHONASUM, 2006-2010.**

Romanian-Hungarian bilateral project, RO-HU 7/2013 - **The synthesis of TiO₂, WO₃, noble metal (Au, Pt) and carbon nanotube containing composite materials with differently shaped nanocrystals. A "chess game in materials science", 2013-2015.**

Romanian-Greece bilateral project, RO-GR - **Efficient wastewater treatment with nanocrystalline transient metal oxides modified with noble metals and nonmetals, 2012-2014.**

ERANET Project - **Smart functions of packages containing nano-structured materials in food preservation (SMARTPACK), 2014-2015.**

Romanian-Hungarian bilateral project, RO-HU 21/2008 - **Preparation and Characterization of Visible Light Activated Photocatalysts for Water and Air Decontamination, 2008-2009.**

Romanian-Bulgarian cooperation project in the Black Sea region - **Synthesis, physicochemical and morphological characterization and toxicity testing of titanium dioxide (TiO₂) and silica dioxide (SiO₂) polymeric nanoparticles with respect to their application as drug carriers, 2005-2007.**

NATIONAL RESEARCH PROJECTS:

PN-II-Ideas project 306/2011 - **Designing TiO₂ containing composite nanoarchitectures for H₂ production and environmental depollution, 2011-2016.**

GTC-UBB grant – **Grant for young scientists - The synthesis of micro- and nano-sized Bi₂WO₆ for photocatalytic applications, 2016-2017.**

GTC-UBB grant – **Grant for young scientists - Innovative synthesis of TiO₂/WO₃/Au nanocomposites for photocatalytic water decontamination and H₂ production, 2013-2014.**

CEEX-ET project 5911/2006 - **Novel nano-composites based on TiO₂ aerogels and noble metals for applications in water purification and water quality monitorisation, 2006-2007.**