

INSTITUTE OF PHYSICAL CHEMISTRY

PROGRAM II: Nanochemistry, Environment - Friendly Technologies, Energy

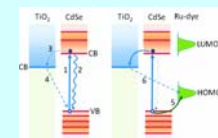
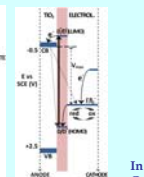
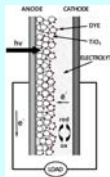
P. Falaras, A. Hiskia, A. G. Kontos, K. Papadopoulos, A. Provata, N. Zouridakis

Photo-redox Conversion and Storage of Solar Energy Laboratory (PCSSE)

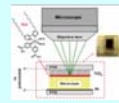
- Development of dye-sensitized solar cells (DSSCs). Research on functional ruthenium dyes, solidified redox electrolytes based on ionic liquid, mesoporous nanostructured and nanotubular titania films. Solar cell optimization in terms of efficiency, life-time and stability.
- Growth of innovative nanostructured photocatalysts for environmental cleaning and health protection. Metal and non-metal titania doping for visible light induced photocatalysis and superhydrophilicity.

DSSC structure and operation

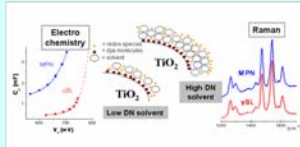
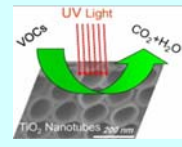
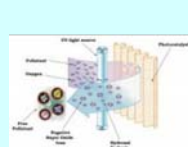
QD sensitized Solar cells



In situ Raman spectrophotoelectrochemistry
Combine Raman and electrochemical techniques
(EIS, IMPs, IMVs) for device investigation (DSSCs)



Self cleaning photodegradation & photoinduced superhydrophilicity



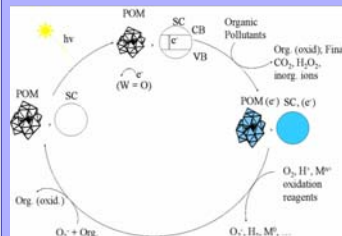
Patents 2010-2011: 2 (1 international, 1 Greek)

EU projects:

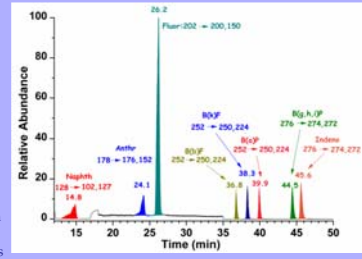
- 2009-2012 "Clean Water-Water detoxification using innovative vi-nanocatalysts", FP7-ENV-NMP-2008-2 STREP, 580 K€, Coordination of the project.
- 2005-2011 "Molecular Engineering of Interfaces of Photonic Devices based on Mesoscopic Oxide layers", COST Action D35- From Molecules to Molecular Devices.
- 2009-2013 "SANS- Sensitizer Activated Nanostructured Solar Cells", FP7-NMP-2009 SMALL-3, 466 K€.

Catalytic - Photocatalytic Processes (Solar Energy - Environment)

Catalytic-photocatalytic reactions for solar energy utilization, environmental detoxification and environmentally friendly processes: aggregates of metal oxides, mainly TiO₂ and polyoxometallates (POM) are used in thermal and photo-chemical reactions.



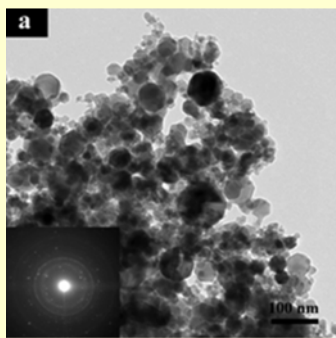
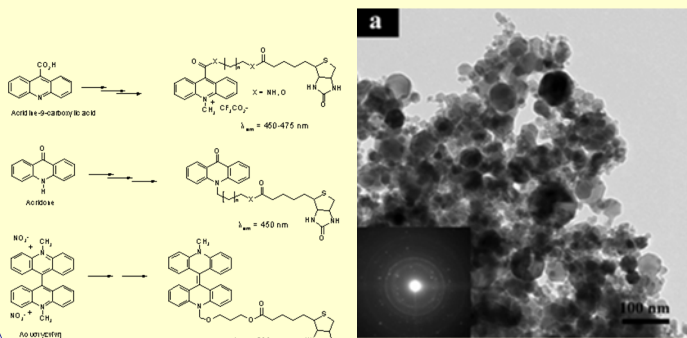
Development of advanced analytical methods for the determination of trace organic pollutants in waters, food and environmental samples (e.g. cyanotoxins, pesticides, PCBs, flame retardants, compounds that give odour or taste in water etc.)



LC-MS/MS SRM chromatograms of a standard solution of the eight PAHs (100 µg L⁻¹ for the six target compounds and 1000 µg L⁻¹ for Naphth, Fluor).

Luminescence Laboratory
Development of Novel Photometric Methods for Analytical Applications

Basic object of the laboratory is the synthesis of novel luminescent compounds and their application in the determination of various quality factors of natural products as well as for detection of biomolecules. Inter alia, the adulteration, the antioxidant activity and the peroxide value in edible oils has been determined. The active substances in pharmaceutical formulations and the detection of biomolecules has been determined, too. For the first time, hybridized nanometer-sized organo-inorganic catalysts have been used in chemiluminescence reactions with much enhanced effects.

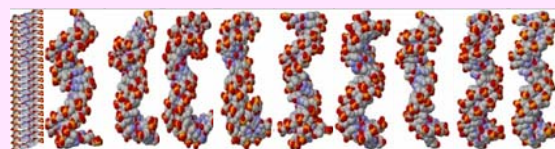
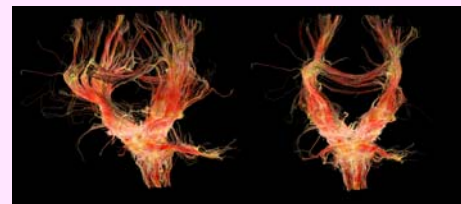
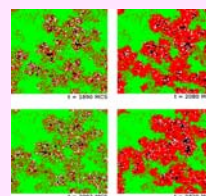


Novel biotinylated luminescent materials for detection of biomolecules

TEM picture of ferric oxide nanoparticles used in CL reactions. The particles are coated with 8-hydroxyquinoline

Statistical Mechanics and Nonlinear Dynamics Lab

We study the dynamics of Complex Systems composed of a large number of nonlinearly interacting elements. Points of interest are fractal structures, spatiotemporal pattern formation, synchronization, long range correlations, scaling properties and network dynamics. Applications: heterogeneous catalysis, human brain dynamics & bioinformatics.



ISOTOPE HYDROLOGY LABORATORY

The purpose of this laboratory is to determine the concentrations of stable and radioactive isotopes in the water circle and eventually help resolve problems concerning a variety of scientific fields (Hydrogeology, Climatology, Physic Atmosphere, Stromatography, Archaeology and Food Chemistry).

Use of environmental isotope hydrology techniques in resolving problems related to the origin of groundwater and the dynamics of the corresponding systems. Application on the optimization of groundwater resources and geothermal energy fields.

