

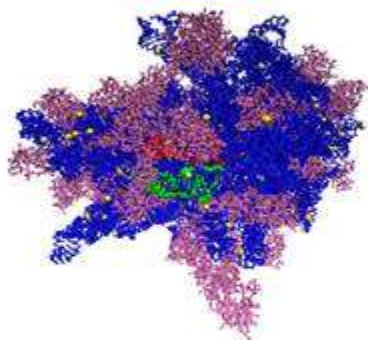
# UNIVERSITY OF WARSAW – CENTRE OF NEW TECHNOLOGIES



## Simulations and experiments on macromolecular nanoscale machines

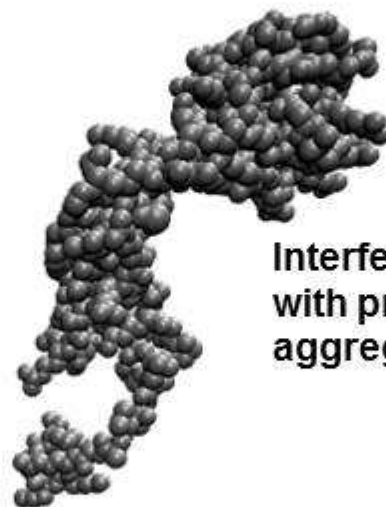
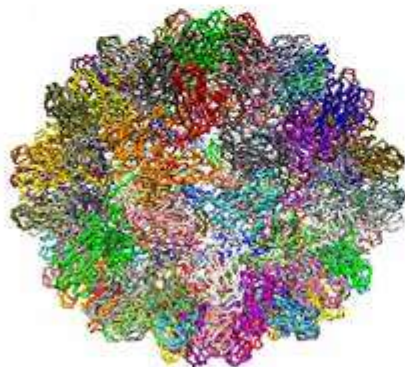


team leader: Joanna Trylska



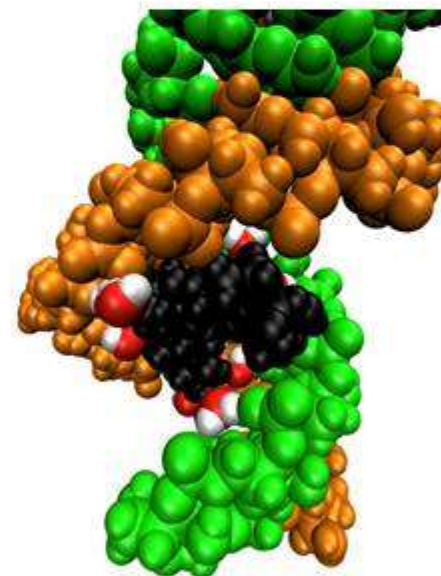
Blocking bacterial  
ribosomes to cure  
diseases

Anti-viral  
compounds



Interfering  
with protein  
aggregation

Design of antibiotics  
targeting RNA



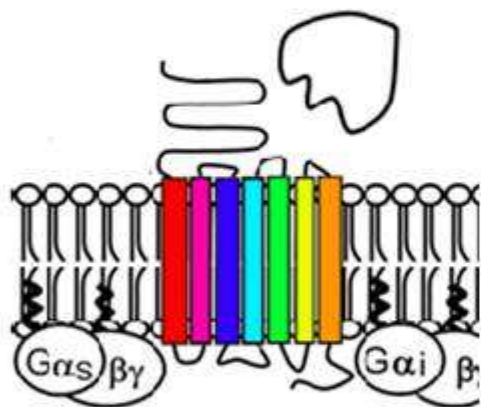
# Chemical and Biological Systems

## Simulation Laboratory

team leader: Bartosz Trzaskowski, PhD

Nanoscience

J. Phys. Chem. C 2014, 117 (38), 19664



GPCR structure prediction, drug design

PNAS 2014, 111 (1), E72

PNAS 2014, 111 (36) 13040

ACS Chem. Biol. 2012, 7 (6), 967

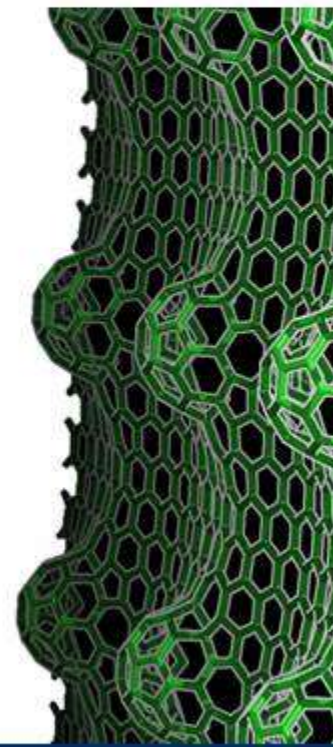


Computational organic/  
inorganic chemistry and catalysis

Organometallics 2013, 32 (13), 3625

Organometallics 2013, 32 (7) 2192

Dalton Trans. 2013, 42, 15271





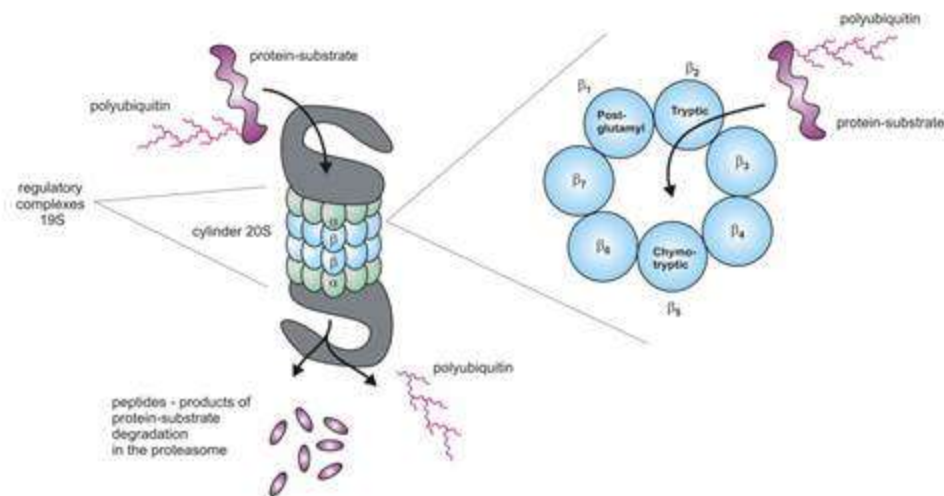
# Laboratory of Experimental Medicine –

dr hab. Dominika Nowis

The aim of the projects carried out in our laboratory is to identify and validate novel molecular targets for anti-cancer therapies with the main focus on mechanisms regulating protein homeostasis in mammalian cells.

We use numerous laboratory techniques including:

- culture of primary and established human and mouse cancer cell lines
- syngeneic *in vivo* tumor models in mice
- enzymatic activity assays
- protein expression and purification
- flow cytometry
- genetic modifications of mammalian cells



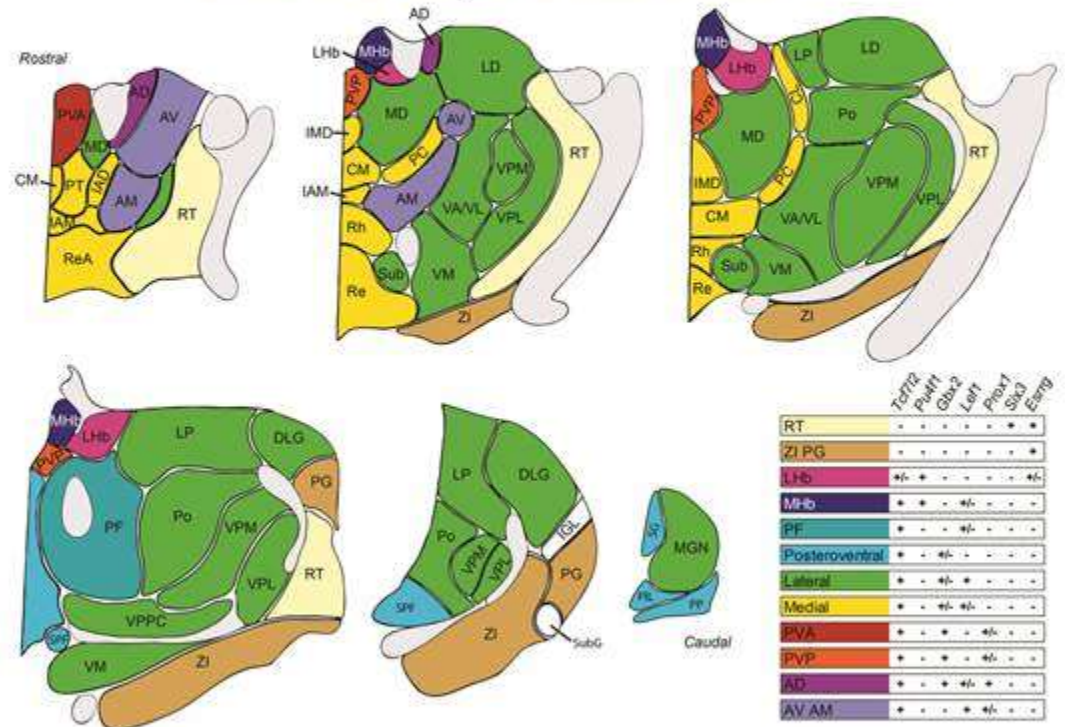


Laboratory of Molecular Neurobiology

dr hab. Marta B Wiśniewska, prof. UW

- Molecular and cellular functions of proteins implicated in pathology of psychiatric disorders
- Mechanism of lithium (psychiatric medication) action
- Development of the thalamic brain
- Generation of conditional gene knockout mice and zebrafish

Molecular anatomy of the thalamic brain



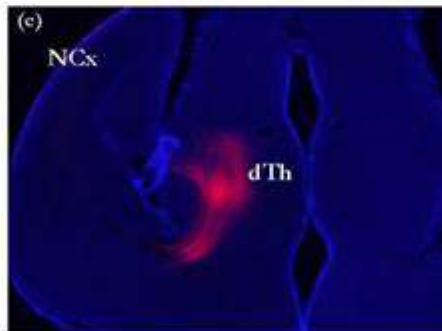
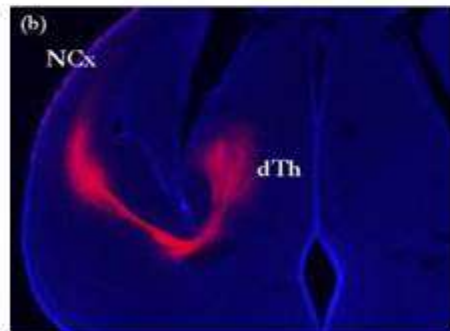
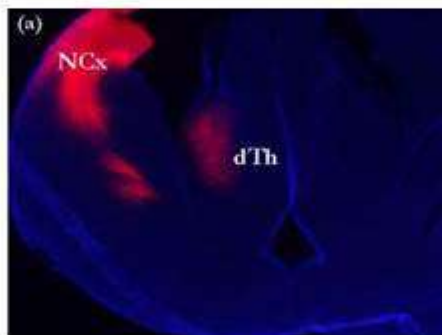
Andrzej Nagalski; Luis Puelles; Michal Dabrowski, Tomasz Wegierski, Jacek Kuznicki, Marta B Wisniewska  
*Transcriptional codes for mouse thalamic neurons*; submitted



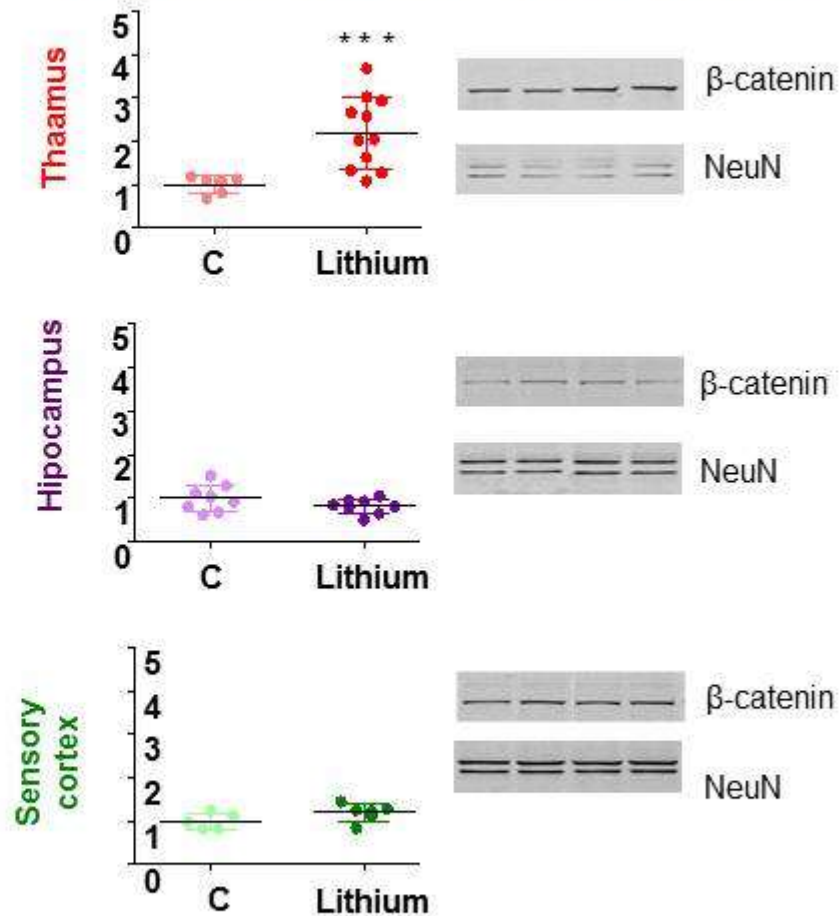
Laboratory of Molecular Neurobiology

dr hab. Marta B Wiśniewska, prof. UW

*Dil tracing of thalamocortical axons in mice  
rostral-to-caudal (a-c) series*



*Effect of lithium on  $\beta$ -catenin activity in the brain*

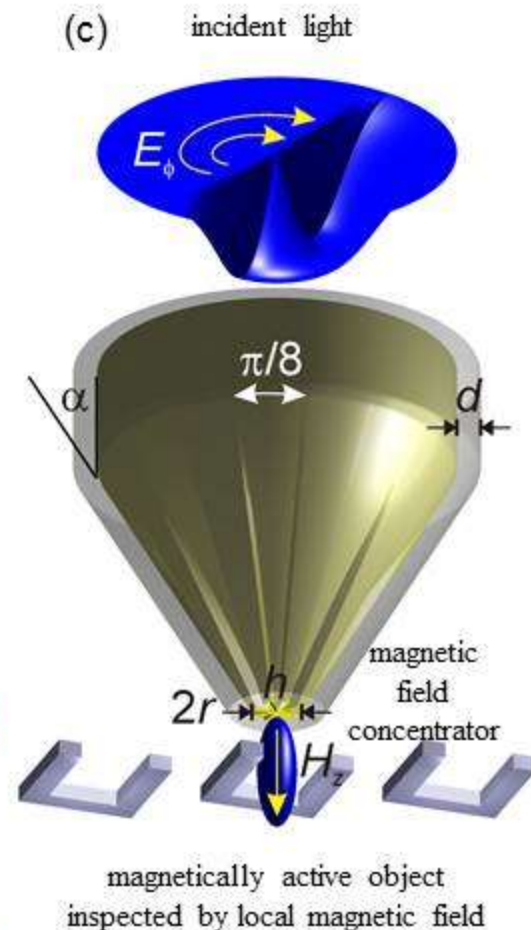
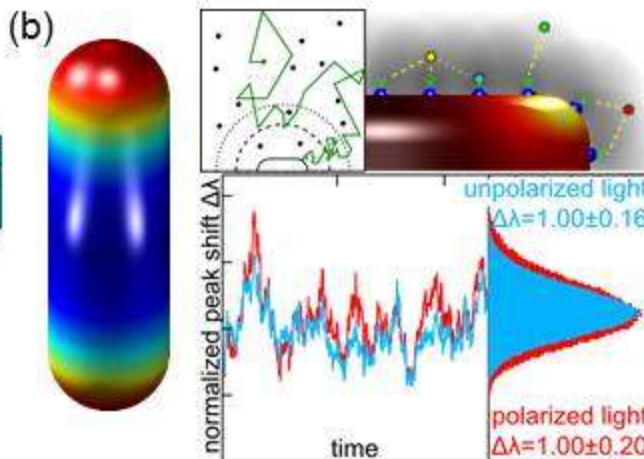


dr Tomasz J. Antosiewicz

(a) Novel hetero-metallic nanostructures for plasmon-enhanced solar harvesting, e.g. solar cells, photoelectrochemical cells, photocatalysis.

(b) Interactions between label-free plasmonic biosensors and analyte molecules – counting single molecules and sensor readout noise minimization.

(c) Nanostructured optical near-field probes for magnetic field based material inspection.



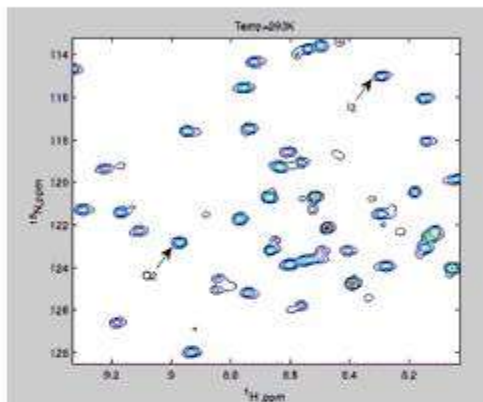


The group develops new methods of NMR spectroscopy dedicated for analysis of complex liquid samples – proteins, natural products and metabolites



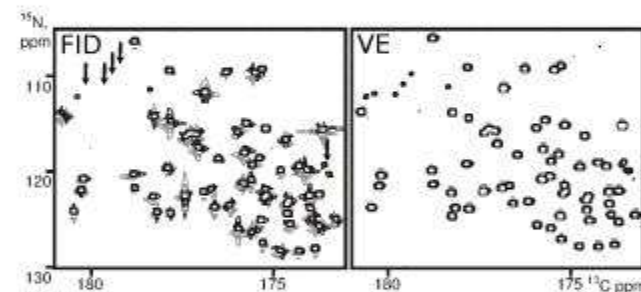
The lab will be equipped with 700 MHz spectrometer (under installation)





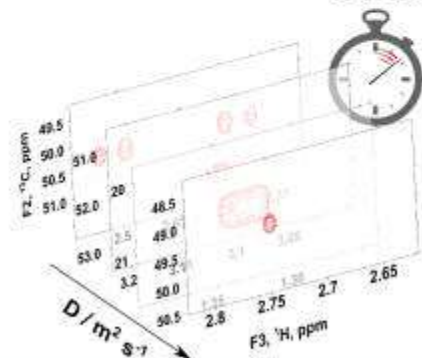
## Temperature-sweep two-dimensional NMR

ChemPhysChem, 15 (11), pp. 2217-2220  
(2014)



## Virtual-echo multidimensional NMR

Chemical Communications, 50 (64), 8947-8950 (2014)



## Fast diffusion-ordered NMR

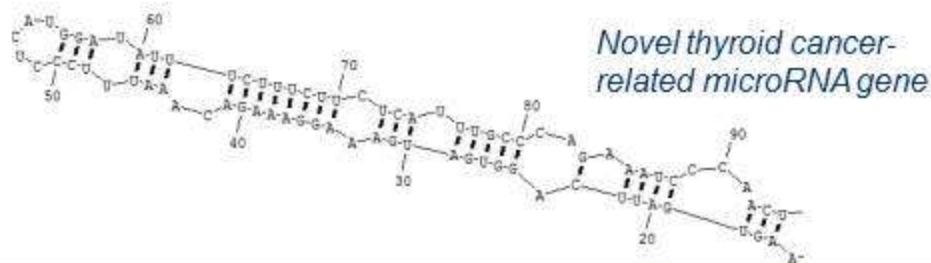
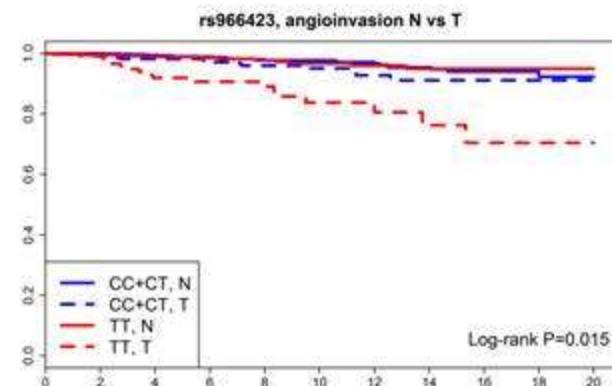
Angewandte Chemie - International Edition, 53 (25), 6464-6467 (2014)

## Laboratory of Human Cancer Genetics

leader: Krystian Jażdżewski, M.D., Ph.D.

- Impact of genetic variants on predisposition and clinical presentation of human cancers
- Novel microRNA genes and their role in tumorigenesis
- Early diagnostics of human cancers based on proprietary genetic tests
- Novel microRNA-based therapeutic strategies for human cancers

*Impact of the SNP on overall mortality of patients with thyroid cancer*



	1																	18
I	H	2											13	14	15	16	17	He
II	Li	Be											B	C	N	O	F	Ne
III	Na	Mg	3	4	5	6	7	8	9	10	11	12	Al	Si	P	S	Cl	Ar
IV	K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr
V	Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe
VI	Cs	Ba		Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Ta	Pb	Bi	Po	At	Rn
VI I	Fr	Ra		Rf	Db	Sg	Bh	Hs	Mt	Ds	Rg	Cn	Uut	Fl	Uup	Lv	Uus	Uuo

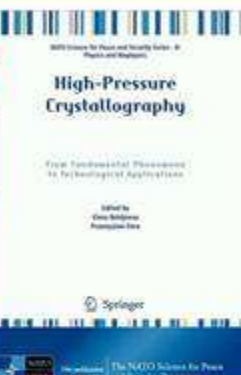
- Hydrogen storage materials
- New superconductors
- Super strong oxidizers
- Ultra high pressures
- Noble gas chemistry
- Magnetic materials

La	Ce	Pr	Nd	Pm	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu
Ac	Th	Pa	U	Np	Pu	Am	Cm	Bk	Cf	Es	Fm	Md	No	Lr

# Theory & Experiment

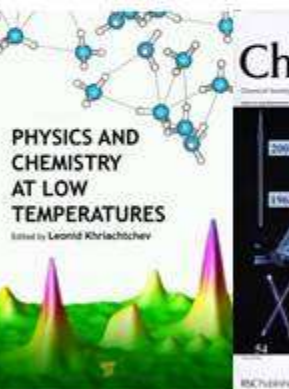
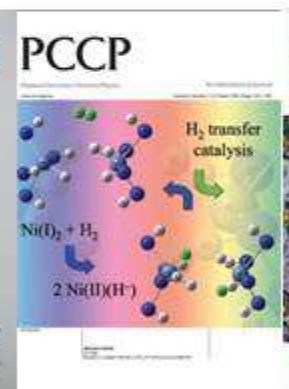
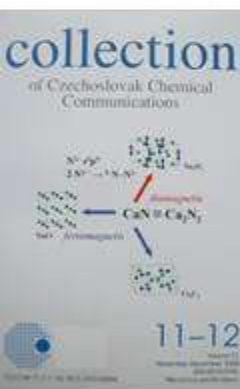


# UNIVERSITY OF WARSAW – CENTRE OF NEW TECHNOLOGIES

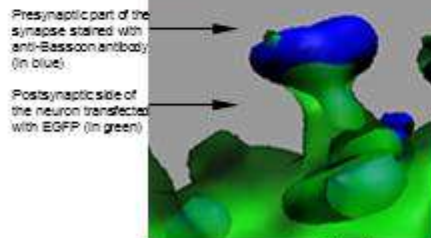
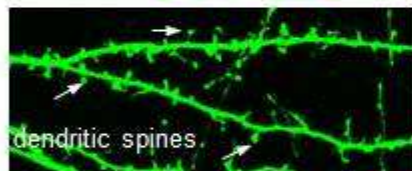
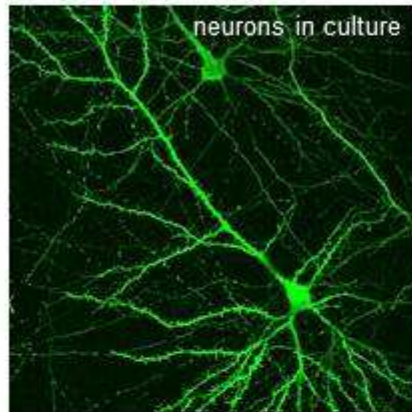


VIP PAPER

HOT PAPER

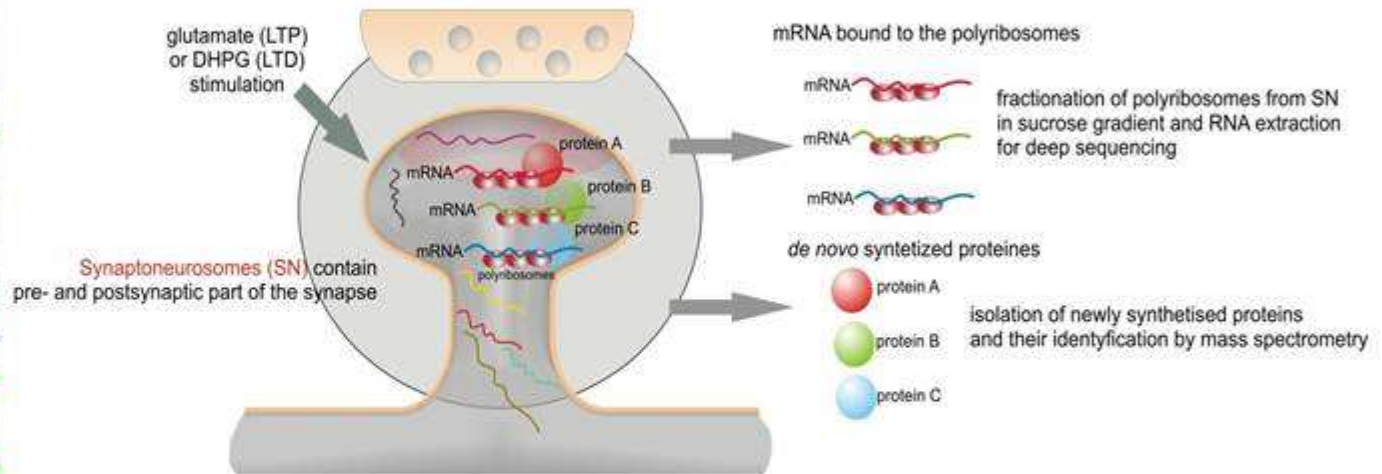


HOT PAPER



synapses on the top of dendritic spines

## Protein synthesis at the synapse



The identification of mRNAs and proteins undergoing local translation at the synapse in response to a specific type of stimulation and understanding of their synaptic functions.

In our studies we use mouse models of human diseases, such as fragile X syndrome in which the process of local translation is impaired (FMR1 KO mice), neuronal cell imaging techniques as well as biochemical and molecular methods, next-generation sequencing and high resolution mass spectrometry.

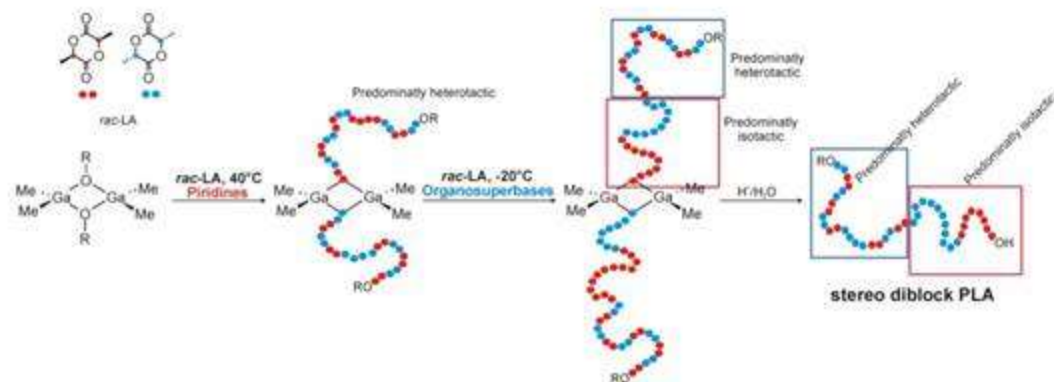
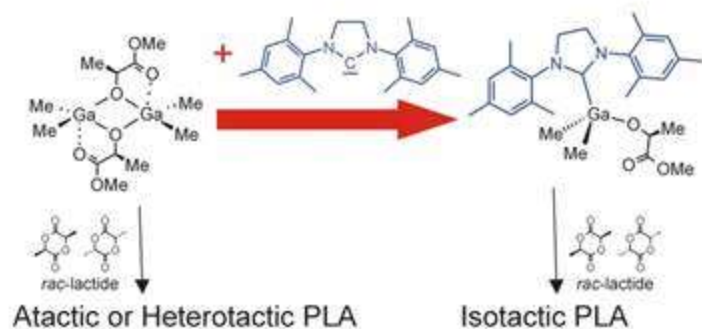


Organometallic Chemistry Laboratory

team leader: Paweł Horeglad, PhD

**From** structure/activity studies of main group metal alkoxides

**To** controlled synthesis of biodegradable polyesters of desired microstructure and properties



P. Horeglad, G. Szczepaniak, M. Dranka, J. Zachara

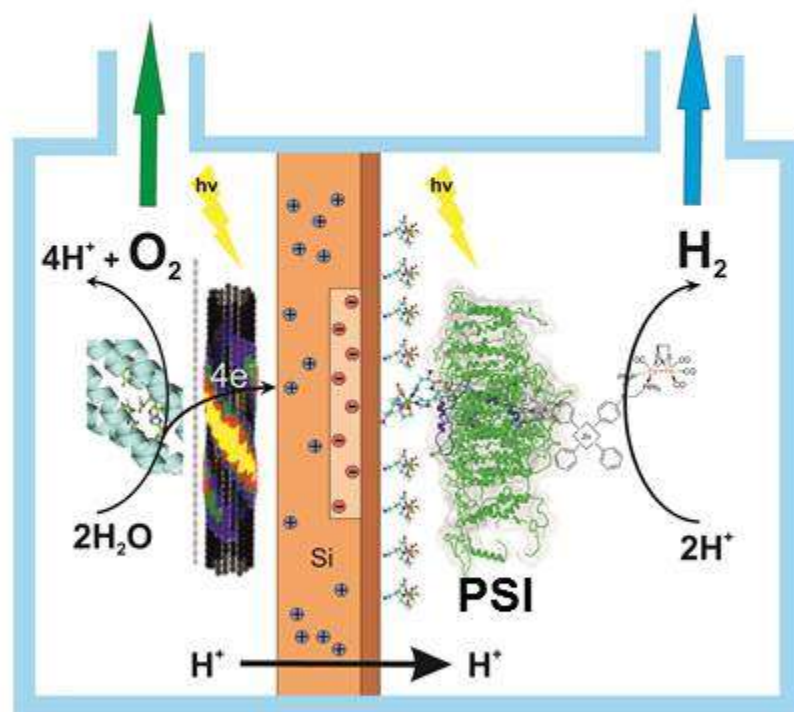
*Chem. Commun.* **2012**, 48, 1171.

P. Horeglad, A. Litwińska, G. Z. Żukowska, D. Kubicki,  
G. Szczepaniak, M. Dranka, J. Zachara

*Appl. Organometal. Chem.* **2013**, 27, 328.

# Solar Fuels Laboratory

Team Leader: Joanna Kargul, Associate Professor



- Construction of biohybrid solar-to-fuel nanodevices using highly robust natural photoconverting photosystem I (PSI)
- Smart matrix design of biohybrid photoelectrodes and photosensors
- Dissecting molecular mechanisms of photoprotection under extreme conditions



## Laboratory of Bioorganic Chemistry

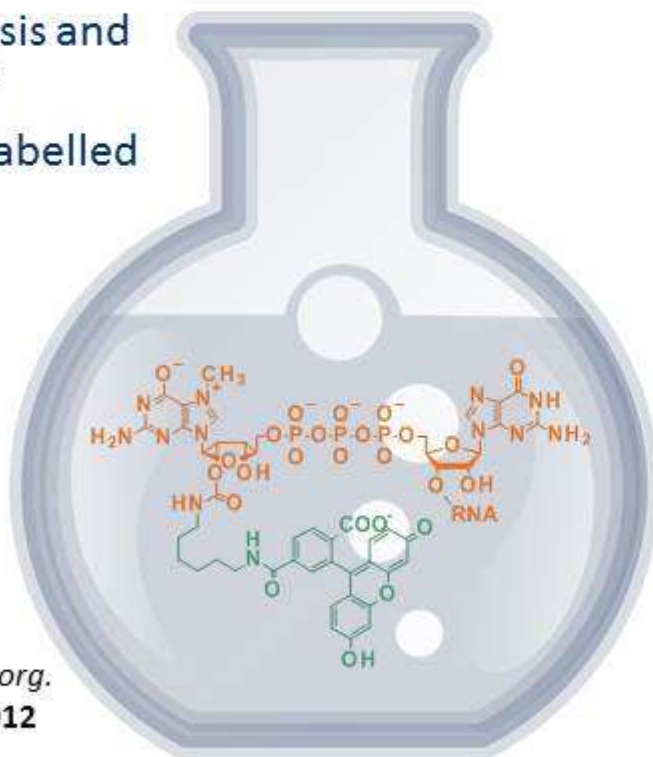
team leader: Jacek Jemielity, PhD DSc

**From** synthesis and properties of modified or labelled nucleotides

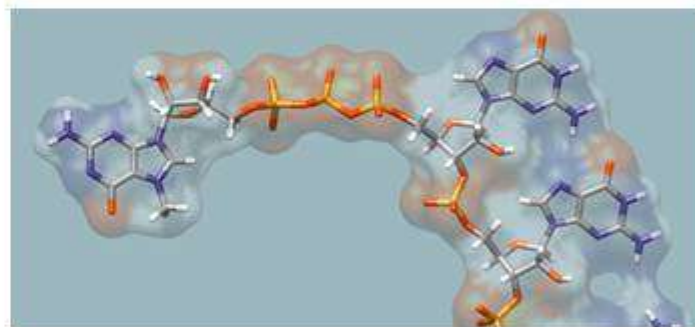
P. Dabrowski-Tumanski et al. *Eur. J. Org. Chem.* **2013**

M. Strenkowska et al. *Org. Lett.* **2012**

J. Kowalska et al. *Bioorg. Med. Chem. Lett.* **2012**



**To** desing of nucleotide-based and mRNA-based anti-cancer therapeutics, screening methods and biotechnological tools



J. Kowalska et al. *Nucl. Acids. Res.* **2014**

M. Warminski et al. *Bioorg. Med. Chem. Lett.* **2013**

W. Su et al. *RNA* **2013**

W. Su et al. *RNA* **2011**

US patents (2012, 2013) and others



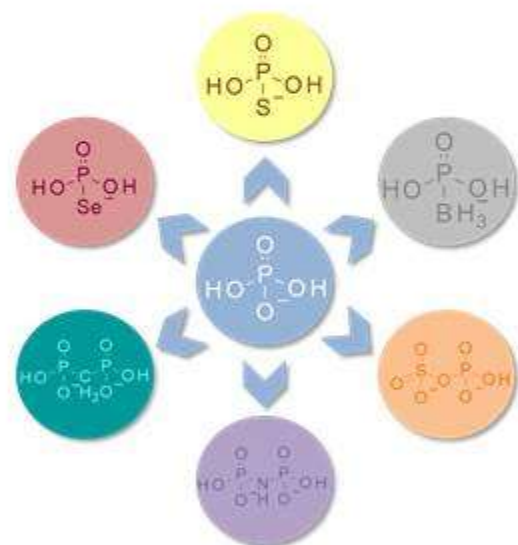


## Laboratory of Bioorganic Chemistry

team leader: Jacek Jemielity, PhD DSc

### Conferring **new properties** to nucleotides through:

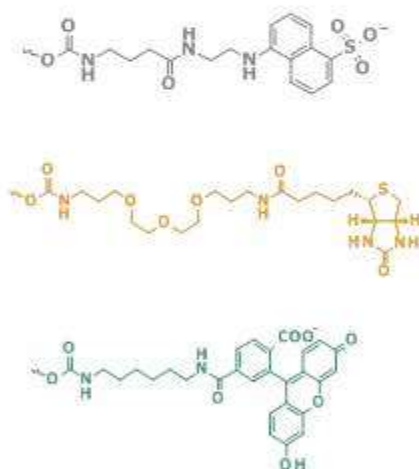
#### Phosphate group modification



#### Increasing stability and affinity

Rydzik et al. *Bioorg. Med. Chem* **2012**  
Kuhn et al. *Gene Ther.* **2010**

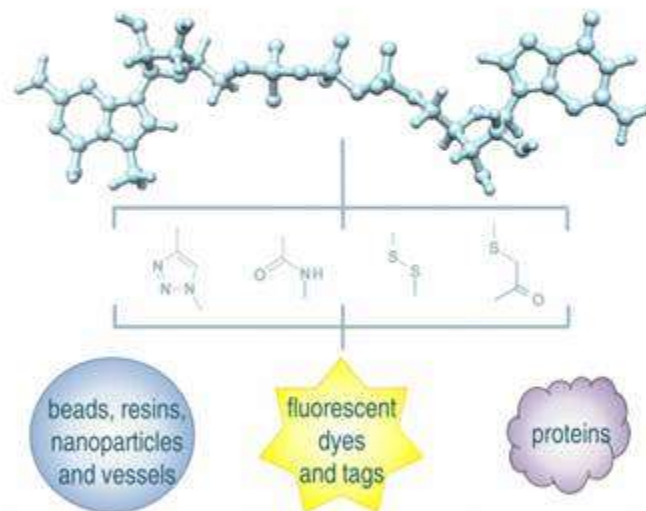
#### Fluorescent or biological labelling



#### Visualization *in vivo*

Jemielity et al. *Org. Biomol. Chem* **2012**  
Kijewska et al. *Biomacromol.* **2013**

#### Conjugation with resins and Nano(bio)materials



#### Affinity purification, delivery into cells

Zochowska et al. *Nanomedicine NBM* **2014**  
Szczepaniak et al. *RNA* **2012**

# Materials Technology Laboratory

## Photonics

- bulk nanoplasmonic materials
- materials with enhanced photoluminescence  
(for solid state lasers, optical amplifiers)
- materials with enhanced up-conversion  
(for high efficiency Si solar cells)
- materials with enhanced nonlinearities  
(for nonlinear absorbers)
- anisotropic materials  
(for filters, directional emissivity control)
- materials with enhanced Faraday effect  
(for optical isolators)

## Oxide single crystals

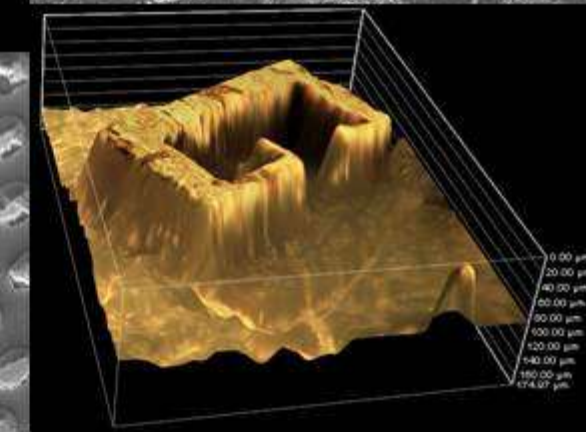
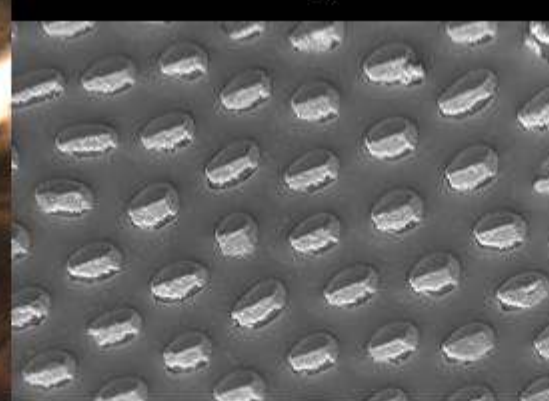
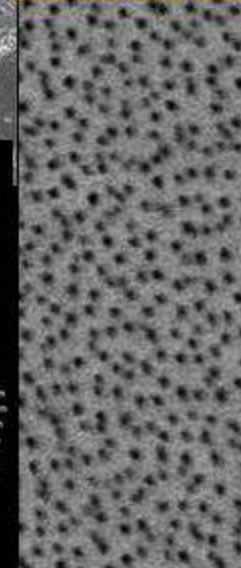
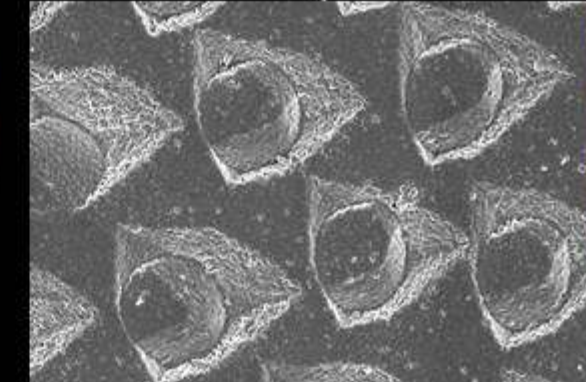
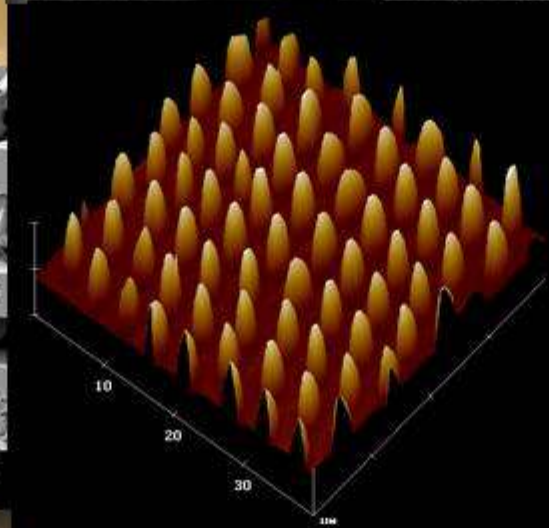
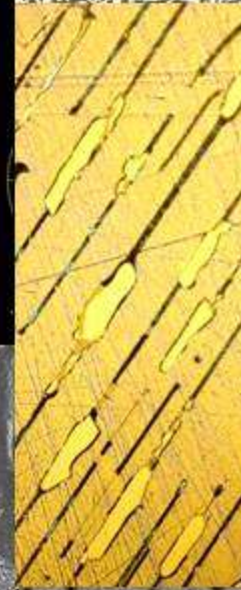
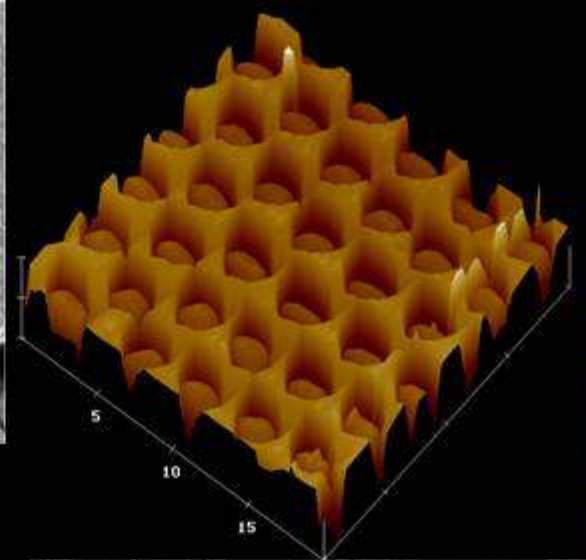
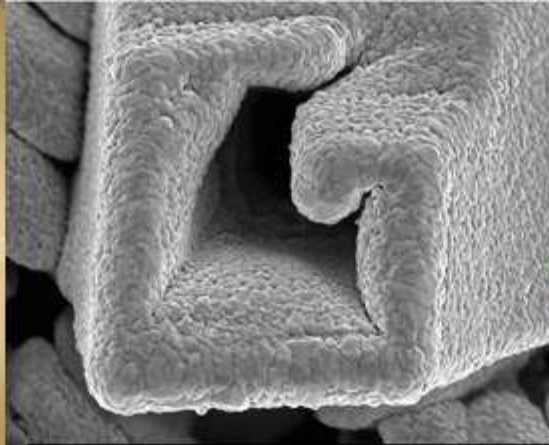
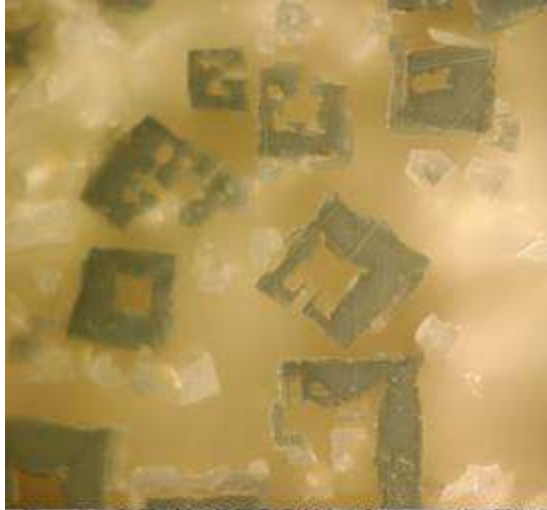
-rods, fibres, plates

## Photoelectrochemistry

- photoanodes in PECs  
(for hydrogen generation)
- water purification

## Photovoltaics Catalysis

- broadband absorption
- porous materials for catalysis

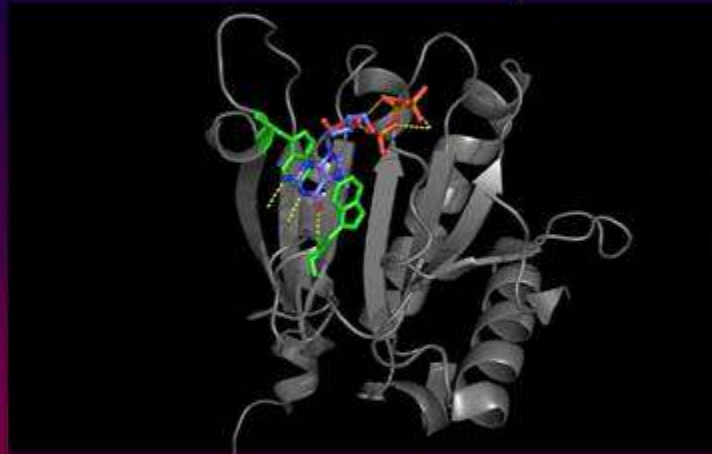


Self-organized materials - manufactured via directional solidification of eutectics

# Interdisciplinary Laboratory of Molecular Biology and Biophysics

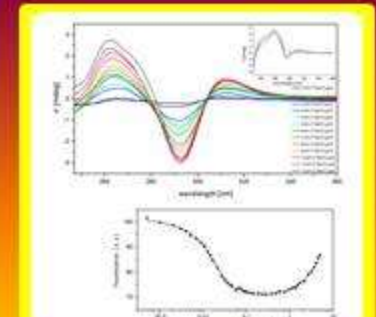
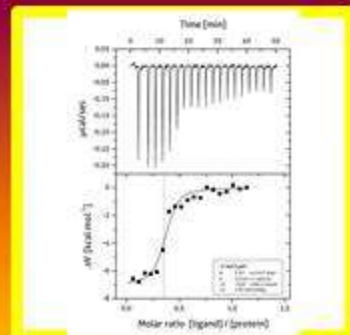
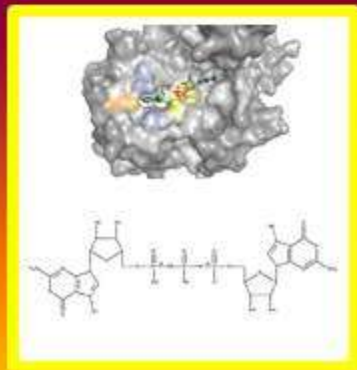
TEAM LEADER:

Prof. Edward Darzynkiewicz



The Laboratory's main field of interest covers the structures of the so-called cap, i.e. the 5' end of mRNAs and many snRNAs.

The main activity of the Laboratory is focused on interdisciplinary studies on the mechanisms of interactions between cap structures and protein regulator factors or enzymes that are involved in processes of protein biosynthesis and mRNA degradation.



# Laboratory of Bioinformatics and Systems Biology

team leader: Krzysztof Ginalski, PhD

The research interest includes development of new theoretical and experimental tools and their application to investigate structure, function and evolution of proteins and their interaction with ligands. Research is also focused on application of next generation sequencing to a wide range of genomic, metagenomic and transcriptomic studies.



# Laboratory for Photoelectrochemistry and Solar Energy Conversion

team leader: Jan Augustyński, Prof

The research conducted in our group is devoted to the study of the interactions of semiconducting materials and metallic nanostructures with light. The investigations focus principally on photo-electrochemical properties of thin-layer semiconducting oxide electrodes, such as tungsten trioxide ( $\text{WO}_3$ ) or ferric oxide ( $\text{Fe}_2\text{O}_3$ ) that are employed to split water or decompose contaminants present in water. In both cases, the photo-electrolysis leads to the formation of hydrogen on the cathode of the cell. Thanks to the light absorption by the semiconducting electrodes, the photo-electrolysis takes place under bias voltages lower than the theoretical value for decomposition of water (1.23 V). The solar-to-chemical energy conversion efficiency relies critically on the composition and preparation method of the semiconducting electrodes; to enable the use of a significant part of the solar spectrum, the employed semiconductors have to have band gap energies in the range of 2 to 2.5 eV.

# Laboratory of Conservation Genetics

## Project:

***„Genetic analysis of economically important fish species in relation to restitution of their populations in Poland”***

## Main aims:

- genetic analysis of ancient and historical samples of extinct species (sturgeon, salmon) in Poland in order to identify the most appropriate source populations for their restitution in Poland
- evaluation of genetic polymorphism, genetic condition and structure of natural populations of different fish species (vimba, whitefish, trout, grayling, pike, cod)
- genetic monitoring of supportive breeding programs helping to prevent negative effect of stocking activity and improve their effectiveness (economically important).

# UNIVERSITY OF WARSAW – CENTRE OF NEW TECHNOLOGIES







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