



Warsaw, 16 October 2012

**One Year Summary Report on the Activity within the NOBLESSE project  
from 1 October 2011 to 30 September 2012  
(for the detailed description of our activity see: [www.ichf.edu.pl/noblesse](http://www.ichf.edu.pl/noblesse))**

## Achievements

### 1. Mazovia Center for Surface Analysis

Mazovia Center for Surface Analysis is a new structure in the Institute of Physical Chemistry. It was created on 22 December 2011 by the regulation issued by the Director of the Institute. Two laboratories were merged to create Mazovia Center for Surface Analysis: Special Laboratory of Electron Spectroscopies (created in 1995) and Special Laboratory of Physical Chemistry of Materials (created in 2004). Now the Center also has the Scanning Electron Microscope financed by the Project Noblesse (Nanotechnology, Biomaterials and alternative Energy Source for ERA integration FP7-REGPOT-CT-2011-285949-NOBLESSE).

Four standards in electron spectroscopy recommended by National Institute of Standards and Technology (USA) were created in our Institute by Prof. Aleksander Jabłoński (2010-2011). Mazovia Center will certainly boost the research.

### 2. Formation of an independent research group by young leader researchers

The Surface Nanoengineering Research Group led by Dr. Joanna Niedziółka-Jönsson started its activities on 1 January 2012. The main goal of their research is to modify conducting and non-conducting surfaces for chemo- and biomolecular detection.

### 3. Recruitment of experienced researches

Following recruitment procedures six experienced researchers joined the groups of Prof. Marcin Opałło (WP2), Prof. Włodzimierz Kutner (WP3), Prof. Jacek Waluk (WP4), and Prof. Janusz Lewiński (WP5):

**Dr. Wojciech Nogala** was appointed to the assistant professor (“adiunkt”) position in the application of scanning electrochemical microscopy (SEM) to the creation of nanomaterials at solid surfaces (WP2, 24 months from 1 January 2012). Dr. Nogala is a high-quality electrochemist who developed his skills in SEM and preparation of nanometer size electrodes during his postdoctoral stay in the group of Professor Michael V. Mirkin (Queens College, New York);

**Dr. Palamisamy Kannan** was employed in the “adiunkt” position (WP2, from October 15th, 2012). He is a high-quality scientist in material science and electrochemistry.



Dr. Kannan will participate in a project entitled: "Design, preparation and studies of surface modified with nanomaterials and/or enzymes for potential application in sensors and cells".

**Dr. Piotr Pięta** was appointed to the "adiunkt" position (WP3, 24 months from 1 August 2012). He is an expert in the area of application of electrochemistry for the determination of biologically significant compounds and in polymer science. Dr. Pięta will focus on devising and fabricating novel thin layer materials of composites of the carbon-based nanostructures coated with multi-polymer films with tunable properties potentially useful for application in both the energy storage and conversion devices as well as chemical sensors for selective determination of biorelevant analytes;

**Dr. Arumugam Sivanesan** was appointed to the "adiunkt" position in advanced Raman spectroscopy (18 months from 1 March 2012). Dr. Sivanesan is currently working on the synthesis of nanoparticles which are properly functionalized for biology-related Raman spectroscopy studies. The first results on optically tuned silver nanoparticles functionalized with mercaptononanoic acid serving as a signal amplifier for the surface enhanced resonance Raman scattering (SERRS) study of methemoglobin were published in (i) Kalaivani G., Sivanesan A., Annan, A., Venkata Narayanan N.S., Kaminska A, Sevel, R., *Langmuir*, DOI: 10.1021/1a303136v. It is the first work published with respect to the SERRS analysis of methemoglobin with preserved nativity of the heme pocket;

**Dr. Piotr Zarzycki** was employed to support the experimental chemical synthesis in the field of "Green nanotechnology – producing an environmentally friendly functional inorganic-organic porous nanomaterials" with theoretical calculations (24 months from 1 October 2011). Dr. Zarzycki joined Prof. Lewiński's group after several years of postdoctoral research in the leading universities and laboratories in the USA. His two works performed in collaboration with US partners have already been published. The first one related to the molecular modeling of anaerobic respiratory electron transfer in the outer membrane protein isolated from *Shewanella Oneidensis* (in this work the possibility of charge conductance through a peripheral decaheme cytochrome was confirmed using the thermodynamic analysis of a minimum free energy pathway of electron injected into the heme sequence) was published in *J. Am. Chem. Soc.*, 2012, 134 (24), 9868–9871 (M. Breuer, P. Zarzycki, J. Blumberger, K. M. Rosso). The other work on the charge migration in metal oxide nanoparticles illustrated by several state-of-the-art X-ray spectroscopic experiments and *ab initio* modeling was published in *Science*, 2012, 337, 1200-1203 (J. E. Katz, X. Zhang, K. Attenkofer, K. W. Chapman, C. Frandsen, P. Zarzycki, K. M. Rosso, R. W. Falcone, G. A. Waychunas, B. Gilbert). This work is a part of the larger project regarding dye-sensitized solar cells based on the iron-oxide nanoparticles and the fluorescence quenching mechanism at the interface as well as the possibility of injecting electrons into metal oxide minerals by microbes like *Shewanella spp.*;

**Dr. Katarzyna Wójcik** was appointed to the "adiunkt" position in the field of functionalization of nanomaterials and preparation of bioconjugates for biochemical/biomedical applications (from 1 October 2012). Dr. Wójcik is a highly



experienced specialist in the field of organometallic and inorganic chemistry as well as biodegradable polymers for biomedical applications. She also has experience in cell culture, *in vivo* studies, and the introduction to clinical trials of biologically active substances.

It should be noted that thanks to NOBLESSE we have encouraged three gifted scientists from the USA and Canada to come back to Europe.

#### 4. Intensification of scientific cooperation

4.1. In collaboration with Sabine Szunerits (Lille, partner in WP2), a new, simple and effective procedure for graphene based material was developed. In a one-step process and mild conditions, we prepared a number of interesting and promising composites based on reduced graphene oxide and various aromatic molecules (dopamine, tetrathiafulvalene, and their derivatives). The activity of all the materials was successfully tested by post-functionalization, using “click” and “thiol-yne” reactions, in a solution (aqueous or organic) as well as on the electrochemically and spectroscopically interesting surfaces. The aromatic molecules and bound elements are rigidly incorporated or can be expelled by oxidation or complex formation, respectively. These composites can be used in sensor and bioassays chemistry as well as chemical and electrochemical switches (e.g. carbohydrate-coated biointerface in glycobiology). The results were published in: (i) Kaminska I., Das M.R., Coffinier Y., Niedziolka-Jonsson J., Woisel P., Opallo M., Szunerits S., Boukherroub R., *Chem. Commun.*, 2012, 48, 1221-1223; (ii) Kaminska I., Das M.R., Coffinier Y., Niedziolka-Jonsson J., Sobczak J., Woisel P., Opallo M., Boukherroub R., Szunerits S., *ACS. Appl. Mater. Int.*, 2012, 4, 1016-1020.

In collaboration with Elisabeth Lojou (Marseille) and Frank Marken (Bath, partner in WP2), we have developed new carbon nanoparticulate or carbon nanotube based electrodes allowing for the efficient mediatorless bioelectrocatalysis of hydrogen with adsorbed thermophilic hydrogenase. These electrodes do not require additional electron shuttle, which makes the system simpler, and they are relatively not sensitive to the presence of oxygen. In the future, they might be applied in a hydrogen-oxygen biofuel cell. Two manuscripts were submitted to *Electroanalysis* and *International Journal of Hydrogen Energy*.

In collaboration with Frank Marken (Bath, partner in WP2), the earlier developed electrode modified with positively and negatively charged carbon nanoparticles was applied successfully for biosensing of H<sub>2</sub>O<sub>2</sub> (with adsorbed myoglobin) and glucose (with glucose oxidase) and also for nonenzymatic neurotransmitters determination. The manuscript was submitted to *Electrochimica Acta*.

One of the topics of the cooperation with Eric Vauthey (Geneva) is related to the so-called Marcus inverted region for highly exoenergetic bimolecular photoinduced electron transfer reactions which, for example, were reported previously (2005-2011) for a series of coumarins and N,N-dimethylaniline in micelles and in room temperature ionic liquids. The results on the effects of viscosity on the kinetics of such reactions and general comments on



their interpretation were published in: Rosspeintner A., Koch M., Gonzalo Angulo, Vauthey E., *J. Am. Chem. Soc.*, 2012, 134, 11396-11399.

Prof. Janusz Lewiński was invited to contribute to the volume on organoaluminum chemistry of the book review series "Topics in Organometallic Chemistry", Springer, covering the most novel and recent structural, bonding, and reactivity aspects of trivalent organoaluminum species. Prof. Lewiński, in cooperation with his Noblesse partner Dr. Andrew E. H. Wheatley (WP5) wrote a chapter entitled: "Simple trivalent organoaluminum species: perspectives on structure, bonding and reactivity" which is on a proofreading stage (this volume is planned to be published in 2012).

4.2. The series of lectures titled "**Combining Science and Management on My Own Example**" started. Already three lectures were delivered by eminent European scientists: Wilhelm T. Huck, Martin Schröder, and Joseph Michl. Six more lecturers already accepted our invitation.

## 5. Industrial/intellectual property rights and business/industry migration

5.1. It is very unique to combine business with science in Poland. In our Institute, however, the Advisory Board procured the **creation of two spin-off companies**. In the Advisory Board there are four representatives of the investors/industry partners: Rafał Bator (Partner and Board Member, Enterprise Investors Corporation, Poland) - 100 million euro investments per year.

Jarosław Kempczyński (McKinsey & Company, Poland)

Michał Olszewski (Opera TFI S.A, Poland)

Tomasz Tuora (President, PZ Cormay S.A., Poland)

Thanks to these partners, last year we established two spin-offs: ScopeFluidics Ltd and Curiosity Diagnostics Ltd. One of them employs now approx. 20 scientists and the other one intends to hire 10 researchers.

Both companies plan to manufacture products for the medical sector. More information can be found in our press release at Alpha Galileo (see

<http://www.alphagalileo.org/ViewItem.aspx?ItemId=114809&CultureCode=en>).

The second note about Curiosity Diagnostics Ltd will follow soon.

5.2. During the first year we filed **32 patent applications** 17 of which were submitted abroad. Most of the patents are for inventions in nanotechnologies and some of them are described in our press releases.

## 6. Promotional campaign

6.1. Thanks to the Noblesse Project we have developed one of the best systems of scientific press releases (certainly the best in Poland and one of the best in Europe). On our web page there are 21 press notes released during the first year of the Noblesse project





([www.ichf.edu.pl/noblesse/press.html](http://www.ichf.edu.pl/noblesse/press.html)). They include nine notes in Polish and 12 in English. Out of these 12 notes six appeared on the ScienceDaily (3 million visitors per month) and on on the TreeHugger (>3 million users). Nine Polish notes appeared at 259 portals and 12 English notes at 530 portals. 6800 visits were registered and 3800 downloads from AlphaGalileo. We have started to publish our notes on the EurekAlert. So far one note has been about graphene and it has been viewed 9000 times. During only one year of the Noblesse project, more people could see the achievements of our Institute than during the whole 60-year history of the Institute.

6.2. The intensive and diversified promotion of visibility of the excellence of the IPC PAS has been carried out (the promotion is addressed to children, pupils, university students, and general public). The project website ([www.ichf.edu.pl/noblesse](http://www.ichf.edu.pl/noblesse)), containing all the information related to the implementation of the project, has been active since mid-November 2011. A wide range of promotional materials, such as notebooks, pens, pencils, color crayons, and canvas bags as well as a promotional flyer and Warsaw City map, have been designed and ordered. The materials are disseminated at a wide range of events, such as conferences, student meetings, etc. A promotional book on the IPC PAS has just been prepared for publication. The promotional/informational movie on the Institute and its activities has been prepared by a professional company with an extensive experience in popularising science and making films about the achievements and work of researchers (the movie is directed by Wiktor Niedzicki, a well-known TV science popularizer).

## Problems

1. The implementation of the extremely rich program of "Transfer of knowledge and experience through **twinning** and networking" is slightly delayed. Twinning agreements between the IPC PAS and its EU partners have to be signed as soon as possible.

Robert Hołyst, Jerzy Herbich, Marcin Opallo