DR HAB. MARCIN ZIÓŁEK

Presentation of research and teaching achievements as the basis for the bestowal of a title of professor of science in physics

Faculty of Physics

Adam Mickiewicz University in Poznań

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I. Professional work

1. Academic and Research Career

Habilitation 2013 Faculty of Physics, A. Mickiewicz University, Poznań, Poland
Title: *Photoinduced processes in molecular systems with proton and electron transfer of potential applications in optical memories and solar cells, studied by time-resolved optical spectroscopy methods*

Ph.D. 2003 Faculty of Physics, A. Mickiewicz University, Poznań, Poland
Title: *The analysis of linear and nonlinear physical processes in the femtosecond two-pulse spectroscopy*
Supervisor: prof. dr hab. Ryszard Naskręcki

M. Sci. 1999 Faculty of Physics, A. Mickiewicz University, Poznań, Poland
praca magisterska pt. *Transient absorption setup with femtosecond resolution – preliminary and test studies*
Supervisor: prof. dr hab. Franciszek Kaczmarek

2. Professional positions

since 2015 Associate Professor, Faculty of Physics, A. Mickiewicz University in Poznań
2008-2015 Lecturer and Researcher, Faculty of Physics, A. Mickiewicz University in Poznań
2003-2008 Lecturer and Researcher, Center for Ultrafast Laser Spectroscopy, A. Mickiewicz University in Poznań
1999-2003 PhD student, Faculty of Physics, A. Mickiewicz University in Poznań

II. Research work

1. Brief account of research achievements prior to habilitation degree

Most of my research work has been concerned with the time-resolved laser spectroscopy, in particular in application to ultrafast processes taking place in the time scale of femtoseconds to nanoseconds. The area of my research prior to habilitation degree covers three groups of subjects. The first group concerns the physical phenomena accompanying ultrafast pump-probe measurements, studied first of all by the femtosecond transient absorption method. The related research work was the subject of my master's degree and doctoral dissertation, accomplished under promotion of Prof. Ryszard Naskręcki from the Faculty of Physics, AMU. Studies in the same area were needed in realization of my first KBN grant no. 2 P03B 136 19 in which I was involved as chief manager (principal investigator) and the so-called supervisor grant no. 2 P03B 040 22. My first papers [2] and [3] presented the measuring setup for transient absorption measurements and the basic methodology of measurements, taking into account the chirp of probe pulses. These papers are included in the list of papers published given in Part III of the self-presentation. The subsequent papers concerned more detail aspects of femtosecond pulses propagation in a sample, related to different group velocities of the pumping and probing pulses, leading mainly to broadening of the time instrumental function and deterioration of time resolution of the system. My most important conceptional achievement in this period is derivation of a relatively simple analytical formula for the instrument response function (IRF), in which the dispersion of the medium and wavelengths of both pulses were taken into account [5] and which permitted calculation of correct time constants of the processes taking place at the border of time resolution of the measuring system. Determination of such a time constant requires the convolution of the theoretical model with the correct IRF that is fitted to the experimental data. Further studies on modification of IRF concerned the influence of the angle between the propagation directions of the exciting and probing beams [7]. The formula for correct IRF that can be subjected to a considerable time-broadening, was also used in [8], which concerned the signals accompanying the overlapping of the pumping and probing pulses in a sample, related to two-photon absorption, forced Raman scattering and mutual phase modulation of pulses. In the same paper I proposed a method for elimination of these undesirable signals. This paper has a very high number of citations, 110 according to Scopus, 200 according to Google Scholar; this difference can be related to its frequent citations in doctoral dissertations and to its concise and attractive title (*Artifacts in femtosecond transient absorption spectroscopy*). In [11] I reported my studies of certain aspects of generation of white light continuum as a probing pulse, that could affect transient absorption measurements. The total number of citations of 6 papers from this group is close to 220 according to Scopus, which gives 2 citations of each of them per year.

The studies of the second group of subjects were carried out in the period of 6 years after doctorate and were related to realization of KBN project no. 2 P03B 015 24 and MNiSW project no. N204 124 31/2853, in which I participated as an investigator and MNiSW project no. N204 149 32/3777, in which I was a chief manager. The objects of studies were the photochromic Schiff bases, in which the process of structural changes related to the change in colour (*cis-trans* isomerization in the C=C bond) is initiated by intramolecular ultrafast proton transfer in excited state. The studies in this area prompted extension of my research competence and experimental skill by the steady-state and time-resolved emission measurements, absorption measurements in longer time scales (from microseconds to seconds) and problems related to photophysics and photochemistry of molecules in differently interacting media. The studies on Schiff bases and proton transfer were imitated in our group thanks to cooperation with Prof. Anna Grabowska from the Institute of Physical Chemistry, Polish Academy of Sciences, in Warsaw, and continued under supervision of Prof. Andrzej Maciejewski from the Faculty of Chemistry, AMU. A few final papers from this series were a result of cooperation with the group of Prof. Abderrazzak Douhal from UCLM in Toledo, Spain. In my first two papers from this series I provided evidence showing that proton transfer in excited state takes place in a very short time, below 50 fs, on the basis of the results of transient absorption for model molecules from salicylidenoaniline family (SA and BSP) [9,10]. This result was in contradiction to the earlier reports claiming that this time was much longer. Our result was later many times confirmed by other research groups by calculations and experimental methods. Determination of such a short time of proton transfer to a high accuracy was possible thanks to the use of the correct form of the IRF described in my earlier published papers. The papers [9] and [10] have been so far cited over 150 times. Similarly fast proton transfer was observed in my subsequent papers for other molecules from this family [15,16,18,19,24,32]. Only in highly protic medium I observed an additional contribution of a slower proton transfer process of the time constant of 400 fs, most probably taking place via the mediation of solvent molecules [21].

An important part of my studies of Schiff bases concerned the effects of the solvent (its polarity, polarizability, protic nature, basicity and viscosity) on the equilibrium of tautomers in the ground state, time of photochromic species formation after proton transfer and photochromic species lifetime [15,18,19,24,36]. The measurements were performed in a wide range of time, from individual picoseconds to milliseconds by time-resolved absorption and emission. In [23] I also reported temperature measurements. Apart from the measurements in different solvents, I extended the Schiff bases dynamic studies over heterogeneous systems such as micelles [19], mesoporous materials of MCM-41 type [20] and zeolites [25]. The compounds studied interact with the environment in different ways, so depending on the environment properties, the dominant initial species were often different and the lifetimes of transient tautomers could be much different and could have different kinetic character e.g. as a result of contribution of second order decays. In this area of my research work (photochromic Schiff bases), my very important achievement was the observation of an ultrafast process competing with proton transfer, that is the *anti-syn* isomerization of the C=N bond [15,18,21,32,36]. This process was found to take place in the primary enol species and leads to formation of tautomer in the ground state which adsorbs in UV range and whose lifetime is much longer than that of the photochromic species. Most probably that is why this process has not been earlier observed, although its occurrence is very important in determination of the yield of the photochromic cycle and possible applications of the compounds studied. In my studies of Schiff bases the experiments was frequently supported or supplemented with computations by numerical methods. In the studies reported in [21,23] I carried out the computation by simple semi-empirical methods and DFT, in [32] in cooperation with the group of Prof. Miquel Moreno from Barcelona, while in [39] – with Dr hab. Aleksander Filarowski from the Wrocław University (the latter paper was published already after I applied for the habilitation degree). To sum up, 14 of papers on photochromic Schiff bases have been cited about 430 times, which gives on average 3 citations per year per paper. In 10 of them I have been the corresponding author.

The third area of my research work before habilitation degree was related to my individual Maria Curie grant (FP7-PEOPLE-IEF-2008 nr 235286) and research training I took in the group of Prof. A. Douhal from UCLM in Toledo, in the years 2009-2011. The project concerned the compounds used in dye-sensitized solar cells (DSSC), in particular determination of their interactions with different nanostructures of titanium dioxide (titania) and in mesoporous silica sieves doped with titania. The main object of studies were the compounds from the family of triphenylamine whose molecules are made of three modules: electro-donor part which is the triphenylamine group, an oligophenylvinyl bridge and a cyanoacrylate group which is an electron acceptor and forms a link to the surface of semiconducting metal oxides. The first paper from this series concerned the dynamics of the model molecule coded TPC1 in different solvents [26], in particular determination of ultrafast decay of locally excited state, decay time of charge-transfer state, the dynamics of solvation and equilibrium between the neutral and anionic species. Subsequent papers concerned the interaction of this molecule with different nanostructures (nanoparticles, nanorods and nanotubes) of titania in suspension [28], mesoporous silicas of MCM-41 type doped with titania [29] and a comparison of the interaction of TPC1 with nanoparticles of oxides of different metal: titanium, zirconium, zinc and aluminium [30]. The subject of [33] was a comparison of interactions of different compounds from the group of triphenylamines with thin films of titania nanotubes supported on conducting glass plates. The main idea of the studies reported in [28,29,30,33] was determination of the rate and yield of electron injection from the triphenylamine excited state to the conduction band of metal oxides and observation of the charge recombination (back electron transfer). The most important achievements in this area of research include: the observation of the fast component of electron injection (~ 100 fs), determination of the fact that a significant stabilization of the relaxed charge-transfer state in the systems of a dye-titania can lead to slower electron injection and proving that the modification of structures of the molecules studied in order to extend their long-wavelength absorption leads to slowing down of electron injection and to a decrease in the quantum yield of the process. If the energy of the relaxed state is below the conduction band of titania, a fast recombination can reduce the efficiency of photovoltaic cells. Moreover, an important observation was that for zinc oxide of a similar position of the conduction band, no fast component of electron injection was detected.

In the same area of research and within the same research training visit, I was also involved in investigation of compounds from the family of squaraine dyes for DSSC application, within the project of *Japanese-Spanish Cooperative Program* (PLE 2009–0015). This involvement resulted in co-authorship of papers [34] and [35]. The former was devoted to the dynamic effects related to the formation of aggregates and energy transfer between them for squaraine molecules supported directly on the glass substrate. The latter paper concerned the rate of electron injection and its recombination for monomers and aggregates of squaraine molecules attached to titania nanoparticles on conducting glass. To sum up, the studies in this area have brought about 7 papers cited till the present about 200 times, so on average 4 citations of each of them per year.

Besides working in the above described areas, in the period before habilitation I was also engaged in the studies of some other research teams. In particular I was involved in the studies of deactivation of compounds from the group of thioketones (with the team of Prof. A. Maciejewski) [6,12], mechanisms of processes taking place in photosynthetic reaction centres

(Prof. A. Dobek and Dr hab. K. Gibasiewicz) [4,14,22] and photophysical processes in porphyrins (Prof. R. Steer, Prof. A. Maciejewski and Prof. A. Douhal) [13,17,27].

2. Research achievements after habilitation

After I was conferred a habilitation degree I was mainly concerned with complete functional dye-sensitized solar cells and recently also perovskite solar cells. This area of studies in related to realization of the following projects. Two projects in which I was chief manager: one project finalized in 2016 was NCN OPUS no. 2012/05/B/ST3/03284, while the other, currently under realization, is NCN SONATA BIS no. 2015/18/E/ST4/00196 and two other projects NCN PRELUDIUM no. 2016/23/N/ST5/00070 and Diamond Grant 0019/DIA/2017/46) in which I am research supervisor. The main technique used in my time-resolved studies was transient absorption in visible and near infrared range, but I also performed emission measurements of cells by the up-conversion method and single photon counting (TCSPC), transient absorption in the mid- infrared range and nanosecond flash photolysis. In measurements by the latter three techniques I cooperated with my colleagues from the Faculty of Physics, Dr Jerzy Karolczak, Dr hab. Jacek Kubicki and Dr hab. Gotard Burdziński. Two papers [31, 37] concerning complete DSSCs were published before habilitation, although then characterization of the cells was much limited and included only determination of photocurrent or photovoltage.

One of the advantages of investigation of complete DSSCs is that the dynamics and yield of charge transfer processes at the dye / metal oxide interface can be significantly different in the isolated system (e.g. in a suspension or for sensitized electrodes in the air) than in the complete cell filled with electrolyte. Another important feature is the possibility of using the same sample for which the photovoltaic parameters were determined in laser spectroscopy measurements. It is of great importance in the context of large scattering of photovoltaic parameters of manually constructed cells and in the search of correlations between the ultrafast dynamics and global cell parameters, which are of particular concern in my studies. It has been also found that complete photovoltaic cells are much more stable in laser measurements because of a fast regeneration of oxidized dye by the electrolyte. It should be emphasized that the investigation of complete photovoltaic cells by time-resolved laser spectroscopy has not been given much attention to, in contrast to a large number of papers on DSSC systems. In view of the above, we have written a review paper on this subject [47] which in the last two years has been cited over 40 times.

Investigation of functional photovoltaic cells implies the need to use more complex techniques for cell preparation and characterization. Thus I had to supplement my knowledge with that of the methods of preparation of reproducible nanomaterial samples and basic characterization of solar cells including determination of the cell parameters (also its efficiency) on the basis of current-voltage curves measured upon simulated standard illumination (AM 1.5), determination of incident photon to current efficiency (IPCE) and photocurrent or photovoltage decay curves. Moreover, charge separation in the cells can take place in a very long time range, from femtoseconds to individual seconds. That is why, to ensure correct interpretation of the fastest processes, it is necessary to determine the slower dynamics of charge transfer. For the latter I started using a rather complex method of electrochemical impedance spectroscopy.

In my studies of dye-sensitized solar cells I used dyes representing a few families. The first group comprised indoline dyes labelled as D149, D358, and recently also D205 and their modifications with silyl anchors. The first paper from this series presented results for the solar cells with D149 obtained by transient absorption method (flash photolysis) in the scale above nanoseconds [38]. I studied the dynamics of decay of interesting transient absorption signals related to Stark effect, generated by the electrons injected to the semiconductor nanoparticles and leading to a shift in the absorption band of the dye molecules attached to the nanoparticles. This effect has been observed at that time for the first time for DSSC and its nature has been extensively studied. The other papers from this series presented the results concerning electron injection and competing processes obtained in the shorter time scales and impedance measurements for the solar cells with D149 [41, 43, 60] and D358 [48]. In [41] we reported a comparison of the solar cells with D149 sensitized on electrodes with titanium or zinc oxides. For TiO_2 the relative photocurrents were 3-4 times higher than for the samples with ZnO, while the charge collection efficiency (measured by electrochemical impedance spectroscopy) and the efficiency of dye regeneration (measured by nanosecond flash photolysis) were comparable for both materials. The significant differences in the photocurrent were found to be related to the character of the fastest processes. The electron injection for ZnO was slower than for TiO_2, while the signal coming from the separated charges (radical-cations of D149) in about 200 ps after excitation was 3 times greater for the samples with TiO_2 than that for ZnO samples. In [43] the fastest processes in the solar cells with D149 were examined in detail and an important role of the dye self-quenching after its excitation (singlet-singlet annihilation mechanism) was discovered. The intensity of self-quenching processes was a consequence of the close distance of the dye molecules attached to the metal oxide surface. It was found that the self-quenching processes can compete with electron injection. The effect of self-quenching was greater for the cells with ZnO than for those with TiO_2. The aim of [48] was a comparison of performance of D358 sensitized solar cells with different type nanostructures of ZnO. For all types of ZnO nanostructures, the efficiency of electron injection was smaller than for the cells with TiO_2 nanoparticles. In interpretation of these results we proposed a rather unusual explanation that one of the reasons for poorer efficiency of the systems with ZnO could be a smaller refraction index of this oxide relative to that of TiO_2. This smaller refraction index is responsible for more effective undesirable energy transfer between molecules of the dye. Finally, in the recent work [60] we compared the charge dynamics in the cells sensitized with D149 dye and its silyl-anchor derivative, in the cells filled with cobalt-based and iodide-based electrolyte, as well as in the electrode with and without additional molecular passivation. Some of the studies of indoline dyes in DSSC I performed in cooperation with the groups of Prof. Juan Anta from the Universidad Pablo de Olavide in Seville and Dr Ramón Tena Zaera from CIDETEC in San Sebastián, from whom we obtained some electrodes for construction of photovoltaic cells and with whom we consulted the results of the impedance spectroscopy.

In cooperation with the group of Prof. Anta we also started investigation of ruthenium dyes. In [44] we reported on the effect of additives to the electrolyte (lithium cations and tertbutylpyridine) on the dynamics of electron transfer and solar cell parameters when using one of the most popular ruthenium dyes - N719. We also compared and analyzed the performance of electrodes based on TiO_2 and ZnO sensitized with N719. The probable reasons for lower efficiency of ZnO electrodes could be slower electron injection, slower dye regeneration, intermediate state in the charge separation process and no effect of additives to the electrolyte. Our very recent studies on ruthenium dyes have been described in two papers [53, 58]. In [53] we have shown, on the example of N719, why cobalt electrolyte (which at present gives the highest laboratory efficiency of DSSC) does not work well with ruthenium dyes. One of the reasons is the back electron transfer from metal oxide to the dye (recombination), which is much faster in a cobalt electrolyte (tens and hundreds of picoseconds) than in the classical iodine electrolyte. Faster recombination together with slower electron injection were also found to be the reasons for lower efficiency of the solar cells with another ruthenium dye coded RuP (widely studied in the aspect of application to water splitting systems). Our studies of this dye are reported in [58].

Four of my papers [46, 50, 52 and 59] are devoted to very effective carbazole dyes performance in DSSC. These dyes were MK-2 and its silylated more stable modification ADEKA-1 which has been recently proposed by a Japanese group and has been used in the

DSSC of the highest laboratory efficiency of over 14%. In [46] we studied the effect of additives introduced to cobalt and iodide electrolytes for the performance of DSSC with MK-2. One of the most important observations was the process of electron recombination whose time constants were reduced in sub-nanosecond range with decreasing energy gap (in consistence with the so-called inverted Marcus region), in contrast to the dynamics of electron injection. Paper [50], written in cooperation with the group of Prof. Anders Hagfeldt from the École Polytechnique Fédérale de Lausanne (EPFL, one of the most important laboratories working on new photovoltaic cells), reported on the effects of different synthesis procedures (performed by Dr hab. Błażej Gierczyk from the Faculty of Chemistry, AMU), addition of co-adsorbent and electrode passivation for DSSC with the best dye ADEKA-1. An important outcome of the studies was minimization of the undesirable fast recombination of electrons for the cells showing the highest efficiency, which was probably related to the optimum orientation of molecules on the TiO_2 nanoparticle surface. The effects of molecular (so-called molecular-capping) and atomic (ALD method) passivation of electrodes, applied in unusual way that is after dye sensitization, were analyzed in detail in [52]. With increasing passivation the rate of electron injection and recombination decreased. In the latest paper [59] we report that in water electrolytes the rates of the two electron transfer processes (injection and recombination) decrease, while the contribution of recombination increases, which deteriorates the cells efficiency with respect to that of the cells with an organic electrolyte (acetonitrile).

The studies of other types of dyes used in DSSC were the subject of a few of my other papers. In [40, 45] we studied the dyes absorbing in the red and near infrared of potential application in tandem cells, in [40] it was the dye coded HY103, obtained from the group from the KTH Royal Institute of Technology in Stockholm, while in [45] the cyanine commercially available dye MK245. In the two systems important factors limiting the efficiency of DSSC proved to be the effects related to formation of aggregates and processes of ultrafast energy transfer between them. In [51] we report on the construction and comprehensive testing of photovoltaic cells sensitized with betalain dyes of natural origin, which were the subjects of study of Dr hab. Gotard Burdziński from the Faculty of Physics AMU. Besides the experimental work, I was also engaged in simulations and computations reported in [42] devoted to determination of the optimum absorption bands of dyes and perovskites used in tandem cells.

In general, one of the most important outcomes of my studies of charge transport dynamics in complete DSSC is observation of the correlation between the relative photocurrent in the cells (short-circuit current divided by the number of adsorbed photons) and the intensity of the absorption signals appearing in the first nanoseconds after sample excitation, proportional to the number of separated charge after electron injection from the dye. This correlation has been observed by us for many different types of dyes and photovoltaic cell configurations. It means that the ultrafast and fast processes (of time constants up to hundreds of picoseconds) determine directly the current intensity in the photovoltaic cells and their optimization can improve the cells' efficiency. This conclusion is in contrast to the opinion based on the results obtained for isolated elements of photovoltaic cells and which has been dominant among DSSC researchers for a long time. This belief was that quantum yield of the fastest charge separation processes was close to 100%, and the improvement in the cells efficiency can be only achieved by optimization of charge transportation by nanoparticles in the range of milliseconds. According to our studies by electrochemical impedance spectroscopy, the slower processes are important in the conditions of high bias voltage and affect other parameters of the cells, such as the fill factor and open circuit voltage but it does not influence the short-circuit current.

I have recently extended the range of systems studied over perovskite photovoltaic cells which in the last few years have been of much increasing interest among those working on photovoltaic cells. The best systems with perovskite sensitized cells have reached efficiency of more than 23%. In my first paper from the series on perovskite solar cells reported the studies of the samples provided by the group of Dr Ramón Tena Zaera, from CIDETEC [49]. Our intention was to compare the rate of hole transfer from the standard perovskite $MAPbI_3$ (where MA is the methylammonium cation) to the organic material spiro-OMeTAD and inorganic CuSCN. An additional outcome of the studies was the relatively simple method for determination of the charge transfer rate constant from perovskite to contact materials, based on the global analysis of transient absorption results measured for different excitation energy. This method enabled isolation of the dynamics of charge separation from the first and second order recombination processes taking place in the same perovskite material. My latest studies are concerned with the perovskite solar cells constructed in our laboratory, using some equipment from the Nanobiomedical Centre of AMU. In [55] we present a comparison of performance of cells made with two materials for hole transportation: spiro-OMeTAD and its cheaper derivative X60. Paper [57] is devoted to analysis of unusual transient absorption signals that appear at stoichiometric concentrations of precursors in the process of perovskite preparation.

At present I am engaged in the studies related to the subjects of the projects under realization and doctoral dissertations supervised by me: dye-sensitized solar cells with silyl anchors, systems for water splitting and perovskite solar cells. We have started cooperation with EPFL and Saule Technologies in the area of perovskite solar cells and we are at the stage of arrangement of the cooperation with the groups of Prof. Gerrit Boschloo from Uppsala and Prof. Licheng Sun from Stockholm for the studies of copper electrolytes for photovoltaic cells and dye systems for water splitting.

I am the author or co-author of 22 papers concerning the complete photovoltaic cells, mainly dye-sensitized solar cells, including two papers published before habilitation [31,37]. These papers have been cited 240 times, and, apart from the papers published in the last two years (2017-2018), each of them has been cited on average 4.5 times per year. In all papers on the studies of photovoltaic cells written after habilitation, making over 90% of all my papers, I have been the corresponding author, which proves that our laboratory has held a pivotal position.

Besides the papers concerned with photovoltaic cells, I have been a co-author of two papers reporting the studies of other research groups [54, 56]. One of them was devoted to new molecular systems (PCBM and $AgPF_6$) for laser lithography. The contribution of my group was to prove, by the transient absorption methods, the formation of radical-cation PCBM in the presence of $AgPF_6$ by electron transfer in the excited state [54]. The other one is a review paper in the renowned journal Chemical Reviews [56] that sums up the studies reported in over 600 papers on ultrafast dynamics of molecules interacting with silica materials, mainly nanostructural ones. These problems are related to my research work prior to habilitation.

III. Summary of scientific activity

1. Publications in JCR (Journal Citation Reports) journals:

Statistical summary:

Number of papers:	60 (37 before the habilitation)
Citations:	1230 (420 before the habilitation), 1000 without self-citations (310 before the habilitation) (based on Web of Science, in other bases: Scopus - 1270, Google Scholar - 1580)
Hirsh index:	h=23 (h=12 before the habilitation), h=21 without self-citations,

Corresponding author: 30 papers (9 before the habilitation)

Average impact factor after the habilitation: 6.80, without paper from Chem. Rev.: 4.84

Average impact factor before the habilitation: 2.86

Papers after habilitation in the journals of highest score
(according to MNiSW list from 26.01.2017):

- 50 points: 1 paper (Chem. Rev.: impact factor IF=47.9)
- 45 points: 3 papers (1x J. Photochem. Photobiol. C: Photochem. Rev.: IF=12.3; 2x ChemSusChem: IF=7.1-7.2)
- 40 points: 9 papers (1x ACS Appl. Mater. Interfaces: IF=7.5; 1x Chem. Eur.: IF=5.3; 4x Phys. Chem. Chem. Phys, IF=4.1-4.5; 3x Dyes & Pigments: IF=3.5-4.0)
- 35 points: 9 papers (5x J. Phys. Chem. C,: IF=4.5-4.8; 1x Langmuir: IF=4.5; 1x J. Chem. Phys.: IF= 3.1; 1x RSC Adv.: IF=3.1, 1x Mater. Chem. Phys.: IF=2.1)

Publications before the habilitation (date of sending the application in January 2013):

1. K. Dobek, J. Karolczak, D. Komar, J. Kubicki, M. Szymański, T. Wróżowa, M. Ziółek, A. Maciejewski,
   Optical calibration of the picosecond time scale and correlated background elimination in fluorescence dynamics measurements by time-correlated photon counting,
   Opt. Applicata, **28** (1998) 201. (IF=0.203)
2. R. Naskręcki, M. Lorenc, M. Ziółek, J. Karolczak. J. Kubicki, M. Szymański, A. Maciejewski,
   Transient absorption experimental set-up with femtosecond time resolution,
   Bull. Pol. Acad. Sci., Chemistry, **47** (1999) 333. (IF=0.325)
3. A. Maciejewski, R. Naskręcki, M. Lorenc, M. Ziółek, J. Karolczak, J. Kubicki, M. Matysiak, M. Szymański,
   Transient absorption experimental set-up with femtosecond time resolution. Femtosecond and picosecond study of DCM molecule in cyclohexane and methanol solution,
   J. Mol. Struct., **555** (2000) 1. (IF=0.849)
4. K. Gibasiewicz, R. Naskręcki, M. Ziółek, M. Lorenc, J. Karolczak, J. Kubicki, J. Goc, J. Miyake, A. Dobek,
   Electron transfer in the reaction center of the photosynthetic bacterium Rb. Sphaeroides R-26 measured by transient absorption in the blue spectral range,
   J. Fluoresc., **11** (2001) 33. (IF=0.702)
5. M. Ziółek, M. Lorenc, R. Naskręcki,
   Determination of the temporal response functionin femtosecond pump-probe systems,
   Appl. Phys. B, **72** (2001) 843. (IF=1.984)
6. M. Lorenc, A. Maciejewski, R. Naskręcki, M. Ziółek, J. Karolczak, J. Kubicki,
   Mechanism and deactivation kinetics of S_2-xanthione in acetonitrile, a quenching solvent, and of S_2-exciplex measured by pico- and femtosecond laser spectroscopy,
   Chem. Phys.Lett., **346** (2001) 224. (IF=2.364)
7. M. Ziółek, R. Naskręcki, M. Lorenc, J. Karolczak, J. Kubicki, A. Maciejewski,
   The influence of the excitation geometry on the temporal resolution in femtosecond pump-probe experiment,
   Opt. Comm., **197** (2001) 467. (IF=1.354)
8. M. Lorenc, M. Ziółek, R. Naskręcki, J. Karolczak, J. Kubicki, A. Maciejewski,
   Artifacts in femtosecond transient absorption spectroscopy,
   Appl. Phys. B, **74** (2002) 19. (IF=2.080)
9. M. Ziółek, J. Kubicki, A Maciejewski, R. Naskręcki, A. Grabowska,
   Excited state proton transfer and photochromism of an aromatic Schiff base. Pico- and femtosecond kinetics of the N,N'-bis(salicylidene)-p-phenylenediamine (BSP),
   Chem. Phys. Lett., **369** (2003) 80. (IF=2.438)

10. M. Ziółek, J. Kubicki, A Maciejewski, R. Naskręcki, A. Grabowska, *An ultrafast excited state intramolecular proton transfer (ESPIT) and photochromism of salicylideneaniline (SA) and its "double" analogue salicylaldehyde azine (SAA). A controversial case,*
Phys. Chem. Chem. Phys., **6** (2004) 4682. (IF=2.076)
11. M. Ziółek, R. Naskręcki, J. Karolczak
Some temporal and spectral properties of femtosecond supercontinuum important in pump-probe spectroscopy,
Opt. Comm., **241** (2004) 221. (IF=1.581)
12. G. Burdziński, M. Ziółek, J. Karolczak, A. Maciejwski
S_2 and S_1 States Deactivation of Thiocoumarin in n-Hexane and Acetonitrile Studied by Femtosecond Fluorescence Upconversion and Transient Absorption Spectroscopies,
J. Phys. Chem. A, **108** (2004) 11160. (IF=2.639)
13. E. K. L. Yeow, M. Ziółek, J. Karolczak, S. V. Shevyakov, A. E. Asato, A. Maciejewski, R. P. Steer,
Sequential Forward S2-S2 and Back S1-S1 (Cyclic) Energy Transfer in a Novel Azulene-Zinc Porphyrin Dyad,
J. Phys. Chem. A, **108** (2004) 10988. (IF=2.639)
14. M. Ziółek, N. Pawłowicz, R. Naskręcki, A. Dobek,
Electron Transfer in the Reaction Center of the Rb. sphaeroides R-26 Studied by Transient Absorption,
J. Phys. Chem. B, **109** (2005) 18171. (IF=4.033)
15. M. Ziółek, J. Kubicki, A Maciejewski, R. Naskręcki, A. Grabowska,
Enol-keto tautomerism of aromatic photochromic Schiff base N,N'-bis(salicylidene)-p-phenylenediamine: Ground state equilibrium and excited state deactivation studied by solvatochromic measurements on ultrafast time scale,
J. Chem. Phys., **124** (2006) 124518. (IF=3.166)
16. M. Ziółek, J. Kubicki, A Maciejewski, R. Naskręcki, W. Łuniewski, A. Grabowska,
Unusual conformational effects in proton transfer kinetics of an excited photochromic Schiff base,
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17. A. Łukaszewicz, J. Karolczak, D. Kowalska, A. Maciejewski, M. Ziółek, R. P. Steer,
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18. M. Ziółek, G. Burdziński, K. Filipczak, J. Karolczak, and A. Maciejewski, *Spectroscopic and photophysical studies of the hydroquinone family of photochromic Schiff bases analyzed over a 17-orders-of-magnitude time scale,*
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19. M. Ziółek, K. Filipczak, A. Maciejewski,
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20. M. Ziółek, I. Sobczak,
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J. Incl. Phenom. Macrocycl. Chem., **63** (2009) 211. (IF=1.165)
21. M. Ziółek, G. Burdziński, J. Karolczak,
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J. Phys. Chem. A, **113** (2009) 2854. (IF=2.899)
22. K. Gibasiewicz, M. Pajzderska, M. Ziółek, J. Karolczak, A. Dobek,
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J. Phys. Chem. B **113** (2009) 11023. (IF=3.471)
23. K. Filipczak, J. Karolczak, M. Ziółek,
Temperature influence on deactivation paths and tautomeric equilibrium of some photochromic Schiff bases studied by time-resolved and stationary spectroscopy,
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24. M. Ziółek, M. Gil, J. A. Organero, A. Douhal,
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25. M. Gil, M. Ziółek, J. A. Organero, A. Douhal,
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26. M. Ziółek , X. Yang, L. Sun, A. Douhal,
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27. A. Synak, M. Ziółek, J. A. Organero, A. Douhal,
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28. M. Ziółek, I. Tacchini, M. T. Martínez, X. Yang, L. Sun, A. Douhal,
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29. M. Ziółek, C. Martín, M. T. Navarro, H. Garcia, A. Douhal,
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30. C. Martín, M. Ziółek, M. Marchena, A. Douhal,
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31. M. Ziółek, C. Martín, B. Cohen, H. Garcia, A. Douhal,
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32. C. Randino, M. Ziółek, R. Gelabert, J. A. Organero, M. Gil, M. Moreno, J. M. Lluch, A. Douhal,
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33. M. Ziółek, B. Cohen, X. Yang, L. Sun, M. Paulose, O. K. Varghese, C. A. Grimes, A. Douhal,
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34. G. de Miguel, M. Ziółek, M. Zitnan, J. A. Organero, S. S. Pandey, S. Hayase, A. Douhal,
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35. G. de Miguel, M. Marchena, M. Ziółek, S. S. Pandey, S. Hayase, A. Douhal,
Femto- to Millisecond Photophysical Characterization of Indole-Based Squaraines Adsorbed on TiO2 Nanoparticle Thin Films,
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36. M. Ziółek, G. Burdziński, A. Douhal,
Long-living Structures of Photochromic Salicylaldehyde Azine: Polarity and Viscosity Effects from Nanoseconds to Hours,
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37. M. Ziółek, C. Martín, L. Sun, A. Douhal,
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J. Phys. Chem. C, **116** (2012) 26227. (IF=4.805)

Publications after the habilitation:

38. G. Burdziński, J. Karolczak, M. Ziółek,
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Phys. Chem. Chem. Phys., **15** (2013) 3889- 3896. (IF= 4.198)
39. K. Filipczak, J. Karolczak, P. Lipkowski, A. Filarowski, M. Ziółek,
Photochromic cycle of 2'-hydroxyacetophenone azine studied by absorption and emission spectroscopy in different solvents,
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40. M. Ziółek, J. Karolczak, M. Zalas, Y. Hao, H. Tian, A. Douhal,
Aggregation and Electrolyte Composition Effects on the Efficiency of Dye-Sensitized Solar Cells. A Case of a Near-Infrared Absorbing Dye for Tandem Cells,
J. Phys. Chem. C, **118** (2014) 194-205. (IF=4.770)
41. J. Sobuś, G. Burdziński, J. Karolczak, J. Idígoras, J. A. Anta, M. Ziółek,
Comparison of TiO_2 and ZnO Solar Cells Sensitized with an Indoline Dye: Time-Resolved Laser Spectroscopy Studies of Partial Charge Separation Processes,
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42. J. Sobuś, M. Ziółek,
Optimization of absorption bands of dye-sensitized and perovskite tandem solar cells based on loss-in-potential values,
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43. J. Sobuś, J. Karolczak, D. Komar, J. A. Anta, M. Ziółek,
Transient states and the role of excited state self-quenching of indoline dyes in complete dye-sensitized solar cells,
Dyes & Pigments, **113** (2015) 692-701. (IF=3.970)
44. J. Idígoras, G. Burdziński, J. Karolczak, J. Kubicki, G. Oskam, J. A. Anta, M. Ziółek,
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J. Phys. Chem. C, **119** (2015) 3931-3944. (IF=4.770)
45. K. Pydzińska, M. Ziółek,
Solar cells sensitized with near-infrared absorbing dye: Problems with sunlight conversion efficiency revealed in ultrafast laser spectroscopy studies,
Dyes & Pigments, **122** (2015) 272-279. (IF=3.970)
46. J. Sobuś, J. Kubicki, G. Burdziński, M. Ziółek,
Carbazole Dye-Sensitized Solar Cells Studied from Femtoseconds to Seconds—Effect of Additives in Cobalt- and Iodide-Based Electrolytes,
ChemSusChem **8** (2015) 3118-3128. (IF=7.116)
47. C. Martín, M. Ziółek, A. Douhal,
Ultrafast and Fast Charge Separation Processes in Real Dye-Sensitized Solar Cells,
J. Photochem. Photobiol. C: Photochem. Rev. **26** (2016) 1-30. (IF=12.317)
48. J. Idígoras, J. Sobuś, M. Jancelewicz, E. Azaceta, R. Tena-Zaera, J. A. Anta, M. Ziółek,
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Mater. Chem. Phys. **170** (2016) 218-228. (IF=2.084)
49. K. Pydzińska, J. Karolczak, I. Kosta, R. Tena-Zaera, A. Todinova, J. Idígoras, J. A. Anta, M. Ziółek,
Determination of interfacial charge transfer rate constants in perovskite solar cells,
ChemSusChem **9** (2016) 1647-1659. (IF=7.226)

50. J. Sobuś, B. Gierczyk, G. Burdziński, M. Jancelewicz, E. Polanski, A. Hagfeldt, M. Ziółek,
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51. M. Wendel, A. Kumorkiewicz, S. Wybraniec, M. Ziółek, G. Burdziński,
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Dyes & Pigments, **141** (2017) 306-315. (IF=3.473)
52. M. Gierszewski, A. Glinka, I. Grądzka, M. Jancelewicz, M. Ziółek,
Effects of Post-Assembly Molecular and Atomic Passivation of Sensitized Titania Surface: Dynamics of Electron Transfer Measured from Femtoseconds to Seconds,
ACS Appl. Mater. Interfaces, **9** (2017) 17102-17114. (IF=7.504)
53. M. Gierszewski, I. Grądzka, A. Glinka, M. Ziółek,
Insights into the limitations of solar cells sensitized with ruthenium dyes revealed in time-resolved spectroscopy studies,
Phys. Chem. Chem. Phys., **19** (2017) 20463-20473. (IF=4.123)
54. M. Duocastella, G. Vicidomini, K. Korobchevskaya, K. Pydzińska, M. Ziółek, A. Diaspro, G. de Miguel,
Improving the Spatial Resolution in Direct Laser Writing Lithography by Using a Reversible Cationic Photoinitiator,
J. Phys. Chem. C, **121** (2017) 16970-16977. (IF=4.536)
55. K. Pydzińska, P. Florczak, G. Nowaczyk, M. Ziółek,
Effects of different small molecule hole transporters on the performance and charge transfer dynamics of perovskite solar cells,
Synt. Met. **232** (2017) 181-187. (IF=2.435)
56. N. Alarcos, B. Cohen, M. Ziółek, A. Douhal,
Photochemistry and Photophysics in Silica-Based Materials: Ultrafast and Single Molecule Spectroscopy Observation,
Chem. Rev. **117** (2017) 13639-13720. (IF=47.928)
57. K. Pydzińska, J. Karolczak, M. Szafrański, M. Ziółek,
Differences in photoinduced optical transients in perovskite absorbers for solar cells,
RSC Adv., **8** (2018) 6479-6487. (IF=3.108)
58. I Grądzka, M Gierszewski, J Karolczak, M Ziółek,
Comparison of charge transfer dynamics in polypyridyl ruthenium sensitizers for solar cells and water splitting systems,
Phys. Chem. Chem. Phys., **20** (2018) 7710-7720. (IF=4.123)
59. A Glinka, M Gierszewski, M Ziółek,
Effects of Aqueous Electrolyte, Active Layer Thickness and Bias Irradiation on Charge Transfer Rates in Solar Cells Sensitized With Top Efficient Carbazole Dyes,
J. Phys. Chem. C, **122** (2018) 8147-8158. (IF=4.536)
60. M. Gierszewski, A. Glinka, I. Grądzka, B. Gierczyk, M Ziółek,
Testing New Concepts in Solar Cells Sensitized with Indoline Dyes – Alkoxysilyl Anchoring Group, Molecular Capping and Cobalt-based Electrolyte,
J. Phys. Chem. C, (2018) DOI 10.1021/acs.jpcc.8b06389 (IF=4.536)

2. Other papers:

Publications in journals not in JCR list:

1. A. Dobek, K. Gibasiewicz, R. Naskręcki, M. Lorenc, M. Ziółek, J. Karolczak, J. Goc, J. Miyake *Transient absorption studies of the reaction center of the photosynthetic bacterium Rb. sphaeroides R-26 in the blue spectral range*, in: PS2001 Proceedings: 12th International Congress on Photosynthesis. CSIRO Publishing: Melbourne, Australia, 2001.pp: S14-008
2. M. Ziółek, N. Wereszczynska, R. Naskrecki, A. Dobek, *Electron Transfer in the Reaction Center of the Rb. sphaeroides R-26 Studied by Transient Absorption*, w: „Photosynthesis: Fundamental Aspects to Global Perspectives" (A. van der Est and D. Bruce, eds), Allen Press 2005, pp. 289-291
3. A. Łukaszewicz, J. Józkowiak, J. Karolczak, D. Kowalska, M. Ziółek, A. Maciejewski, *Spektralne, fotofizyczne I fotochemiczne własności porfiryn cynkowych w stanie S_1 i S_2 na przykładzie tetrafenylo pochodnej porfiryny,* w: "Oblicza Chemii" (praca zbiorowa pod red. M. Sikorskiego), Poznań 2006, str. 5-25
4. A. Maciejewski, G. Burdziński, K. Dobek, A. Grabowska, J. Karolczak, E. Krystkowiak, J. Kubicki, A. Łukaszewicz, R. Naskręcki, M. Ziółek, *Właściwości spektralne i fotofizyczne wybranych cząsteczek aromatycznych i indywiduów przejściowych w krótkożyjących stanach wzbudzonych*, Wiadomości Chemiczne, **61** (2007) 137.
5. W. Giera, K. Gibasiewicz, V.M. Ramesh, M. Ziółek, J. Karolczak, A. Dobek, and A. N. Webber, *A0->A1 electron transfer in Chlamydomonas reinhardtii Photosystem I with replaced A0 axial ligand*, w: „Photosynthesis. Energy from the Sun. 14th International Congress on Photosynthesis", Allen, J.F.; Gantt, E.; Golbeck, J.H.; Osmond, B. (Eds.), 2008, Springer, Heidelberg

Currently submitted manuscripts:

1. K. Pydzińska-Białek, J. Szeremeta, K. Wojciechowski, M. Ziółek, *Insights into the femtosecond to nanosecond charge carrier kinetics in perovskite materials for solar cells*, submitted to J. Phys. Chem. C;
2. I. Grądzka, M. Gierszewski, M. Ziółek, *Quasi-reversible proton adsorption phenomenon on the sensitized TiO2 surface in hydrochloric acid*, submitted to Biomimetics;
3. B. Quere, K. Pydzińska-Białek, J. Karolczak, G. Nowaczyk, E. Coy, M. Ziółek, *Understanding the role of different synthesis conditions on the physicochemical properties of mixed-ion perovskite solar cells,* submitted to J. Mater. Chem. A.

3. Presentation at conferences:

International conferences:

1. M. Lorenc, M. Ziółek, R. Naskręcki, J. Karolczak, J. Kubicki, A. Maciejewski
„Femtosecond study of DCM molecule in cyclohexane and methanol solution"
VIth Dutch-Polish Colloquium „Crossroads of Condensed Matter and Opical Physics"
Poznań, 11-12.02.2000
poster
2. M. Ziółek, R. Naskręcki, M. Lorenc, J. Karolczak, J. Kubicki
„The effect of group velocity dispersion on pump-probe type of experiments with femtosecond time resolution"
Physique en Herbe 2000, Lille, France, 19-24.06.2000
poster
3. M. Ziółek, R. Naskręcki, M. Lorenc
„The influence of excitation geometry and sample thickness on the temporal resolution in femtosecond pump-probe experiments"
ESF-ULTRA spring school on "Ultrafast technology and advanced microscopy applications to intra-cellular and biomolecular dynamics", Cargese, France, 25-31.03.2001
poster + 5 min. oral
4. M. Ziółek, R. Naskręcki, J. Karolczak, J. Kubicki,
"Temporal and spectral properties of the femtosecond supercontinuum under different generation conditions",
Ultra School on "Ultrafast processes in Photochemistry and Photobiology", Toruń, 25-30.08.2003
poster
5. M. Ziółek, J. Kubicki, A Maciejewski, R. Naskręcki, A. Grabowska,
"Excited state proton transfer and competitive processes in aromatic Schiff bases",
Polish Photoscience Seminar, Warsaw, 16-17.10.2003
oral
6. M. Ziółek, J. Kubicki, A Maciejewski, R. Naskręcki, A. Grabowska,
"Excited state intramolecular proton transfer reaction and photochromism of the new family of Schiff bases",
International Conference on Transient Chemical Structures in Dense Media, Paris, France, 14-16.03.2005
oral
7. M. Ziółek, M. Gil, J. A. Organero, A. Douhal,
"Fs dynamics of salicylaldehyde azine structures in solution and within nax/nay faujasite zeolites"
XXIV International Conference on Photochemistry, Toledo, Spain, 19-24.07.2009
oral

8. M. Ziółek , X. Yang, L. Sun, A. Douhal,
“Forward and back electron transfer in new dyes interaction with titania nanoparticles for solar cell systems”,
Hybrid and Organic Photovoltaics Conference HOPV 2010, Assisi, Italy 23-27.05.2010
poster
9. M. Ziółek, C. Martín, J. A. Organero, M. Navarro, X. Yang, H. Garcia, A. Douhal
“Studies of new mesoporous materials interacting with an organic dye for the alternative charge collection network in solar cells”,
Hybrid and Organic Photovoltaics Conference HOPV 2011, Valencia, Spain, 15-18.05 2011.
poster
10. M. Ziółek, G. Burdziński, J. Karolczak, C. Martín, Abderrazzak Douhal
“Partial charge separation processes of complete and efficient dye-sensitized solar cells studied by time-resolved laser spectroscopy”
Hybrid and Organics Photovoltaics HOPV13, Seville, Spain, 5-8.05.2013
oral
11. M. Ziółek
“Ultrafast studies of charge transfer processes in dye-sensitized solar cells”,
Molecules and Light 2013, Zakopane, 23-27.09.2013
invited lecture
12. M. Ziółek, J. Karolczak, M. Zalas, Y. Hao, H. Tian, A. Douhal,
“Dye aggregation effects on the electron injection and the competing processes in dye sensitized solar cells.”,
Hybrid and Organic Photovoltaics Conference HOPV14, Lausanne, Switzerland, 11-14.05. 2014.
poster
13. M. Ziółek
“Ultrafast Processes of Charge Separation at the Interface Between Organic Dyes and Metal Oxides Nanostructures in Dye-Sensitized Solar Cells”
EMN (Energy Materials Nanotechnology) Meeting, Istanbul, Turkey, July 1-4.07.2015
invited lecture
14. M. Ziółek, J. Idígoras, G. Burdziński, J. Karolczak, J. A. Anta,
“Ruthenium dyes in dye sensitized solar cells: mechanism of initial charge separation reinvestigated”,
21st International Symposium on the Photochemistry and Photophysics of Coordination Compounds (ISPPCC 2015), Cracow, 5-9.07.2015
oral
15. J. Sobuś, K. Pydzińska, G. Burdziński, J. Karolczak, J. A. Anta, R. Tena-Zaera, M. Ziółek
“Laser spectroscopy studies of nanostructured solar cells”
Nanotech Poland, Poznań, 22-25.06.2016
oral

16. M. Ziółek,
    "Metal oxides in dye-sensitized and perovskite solar cells",
    E-MRS Fall Meeting, Warsaw, 19-22.09.2016
    invited lecture
17. M. Gierszewski, A. Glinka, I. Grądzka, K. Pydzińska, M. Ziółek
    "Can ultrafast laser spectroscopy improve the performance of solar cells?",
    Polish Photoscience Seminar 2018, Krutyń, Poland, 11-14.06.2018
    oral
18. M. Gierszewski, A. Glinka, I. Grądzka, K. Pydzińska, M. Ziółek
    "Correlation of ultrafast charge transfer dynamics with the performance of dye-sensitized and perovskite solar cells",
    27th PhotoIUPAC 2018 International Symposium on Photochemistry, Dublin, Ireland, 8-13.07.2018
    oral

Domestic conferences:

1. M. Ziółek, M. Lorenc, R. Naskręcki
   „Artefakty w femtosekundowej spektroskopii absorpcji przejściowej"
   Mikrosympozjum laureatów konkursu „Fastkin", Poznań, 22-23.05.2000
   poster
2. J. Kubicki, A. Maciejewski, R. Naskręcki, M. Ziółek, A. Grabowska
   „Przenoszenie protonu w fotochromowej zasadzie Schiffa obserwowane w femtosekundowej skali czasu"
   Ogólnopolskie seminarium „Ultraszybkie procesy w fizyce, chemii i biologii"
   Warszawa, 3.06.2002
   oral
3. M. Ziółek, G. Burdziński, K. Filipczak, J. Karolczak, A. Maciejewski, R. Naskręcki, S. Starkowski,
   „Badanie przenoszenia protonu i indywiduów przejściowych uczestniczących w cyklu fotochromowym hydrochinonowej rodziny zasad Schiffa",
   XI Mikrosympozjum „Kinetyczne metody badania mechanizmów reakcji w roztworach", Poznań, 25.05.2007
   oral
4. M. Ziółek,
   „Wpływ międzycząsteczkowych wiązań wodorowych na cykl fotochromowy zasad Schiffa",
   Polish Photoscience Seminar, Warszawa, 11-12.06.2008
   oral
5. M. Ziółek
   „Fotoogniwa barwnikowe badane za pomocą spektroskopii laserowej",
   II Ogólnopolskie Sympozjum Interdyscyplinarne, Wojanów, 20-23.11.2014
   invited lecture

In addition, I was co-author of 16 oral and 34 posters presentation at conferences, presented by other people.

4. Invited presentation in scientific centers:

1. M. Ziółek,
„The effect of solvent on the photochromic cycle of some aromatic Schiff bases: from femtosecond to millisecond spectroscopic studies",
Univesidad de Castilla La Mancha, Toledo, Spain, 12.12.2008
2. M. Ziółek
"Studies of a near infrared absorbing dye for tandem solar cells",
Universidad de Castilla La Mancha, Toledo, Spain, 4.07.2013.
3. M. Ziółek
"Studies of indoline dye D149 sensitized solar cells: from femtoseconds to seconds",
Universidad de Castilla La Mancha, Toledo, Spain, 16.07.2013.
4. M. Ziółek,
"Czy ultrakrótkie impulsy laserowe są potrzebne do badania ogniw słonecznych?",
Academic Centre for Materials and Nanotechnology, AGH, Cracow, 15.03.2018.

In addition, I gave over a dozen or so seminars at the home university (Faculty of Physics and Faculty of Chemistry, Adam Mickiewicz University), mainly before the habilitation.

5. Project manager (principal investigator) in research grants:

1. KBN project no. 2 P03B 136 19 (Polish): "Investigation and analysis of artefacts appearing in the transient absorption measurements in femtosecond time scale" 2000–2001, 5 000 EUR
2. MNiSW project no. N204 149 32/3777 (Polish): "Influence of environment on photochromism. Investigation of intramolecular proton transfer and photoinduced structural changes in some aromatic Schiff bases " 2007-2010, 60 000 EUR.
3. Project: NCN OPUS programme (Polish) 2012/05/B/ST3/03284: "Elementary charge-separation processes in dye-sensitized solar cells studied by time resolved optical spectroscopy", 2013-2016, 145 000 EUR.
4. Project: NCN SONATA-BIS programme (Polish) 2015/18/E/ST4/00196 (SONATA BIS): „Studies of the interaction of silyl-anchor dyes with metal oxide nanoparticles", 2016-2020, 275 000 EUR.

6. Participation in other research grants:

1. KBN project no. 2 P03B 040 22 (Polish): "Analysis of linear and nonlinear physical processes in the femtosecond two-pulse spectroscopy", 2002-2003, 8 000 EUR (principal researcher - PhD grant)
2. KBN project no. 2 P03B 015 24 (Polish): "Molecular aspects of photochromism. Photoinduced proton transfer in selected Schiff bases studied by ultrafast optical spectroscopy" 2003-2005, 38 000 EUR (researcher).
3. MNiSW project no. N204 124 31/2853 (Polish): "Spectral, photophysical and photochemical properties of some molecular probes. The role of hydrogen bonds, spectroscopically non-observable states and reversible photochemical reaction on the deactivation processes of excited molecules", 2006-2009, 90 000 EUR (researcher)
4. Project: Strategic Japanese-Spanish Cooperative Program (PLE 2009–0015): Design, exploration and fabrication of solar cells based on new materials with high conversion efficiency (NANOCONV), 2009-2013, 250 000 EUR (researcher).
5. Marie Curie grant within the UE 7th Framework Programme (FP7-PEOPLE-IEF-2008 no. 235286: From Femto to Millisecond and From Ensemble to Single Molecule Photobehavior of Some Nanoconfined Organic Dyes for Solar Cells Improvement (NANOSOL), 2009-2011, 100 000 EUR (principal researcher).
6. Project: NCN PRELUDIUM programme (Polish) 2016/23/N/ST5/00070: “Time-resolved studies of perovskite materials used in the most efficient solar cells”, 2017-2020, 34 000 EUR (supervisor).
7. MNiSW project “Diamentowy Grant” (Polish) 0019/DIA/2017/46: “Studies of charge transfer dynamics between perovskites and electron or hole transporting layers in solar cells”, 2017-2021, 50 000 EUR (supervisor).

7. Managing research teams

As part of the projects that I led (no. 2 and 3), I organized and planned measurements in cooperation with several of my colleagues from the Faculty of Physics and Chemistry at Adam Mickiewicz University, who performed particular tasks as part of their additional work. I also supervised the work of PhD students and students related to the subject of these projects.

The implementation of my current project (no. 4) of SONATA BIS consisted in setting up my own team, which is financed entirely from this project and whose members (one post-doc and two PhD students) perform only tasks related to it. Together with the role of a scientific supervisor in the PRELUDIUM and Diamond Grant project, I currently manage a group of 4-5 people who was informally named Solar Energy Conversion (SOLENCON) Group and whose research is presented on the website: www.solencon.home.amu.edu.pl.

8. Internships abroad:

- Spain, Toledo, Universidad de Castilla La Mancha, group of prof. A. Douhal:
  - 3-weeks measurements session (2008);
  - 2 years postdoctoral internship - individual Marie Curie scholarship (2009-2011);
  - 4-weeks scientific internship (2012);
  - 4-weeks scientific internship (2013).
- Spain, Castellón, Universitat Jaume I, group of prof. J. Bisquert:
  - participation in "The Impedance Spectroscopy School", 1 week (2010).
- Francja, Lille, Université Lille 1, grupa dr. G. Buntinx'a :
  - 1-week measurements session (2000).

9. Reviewing scientific publications and grants

Reviewer of papers (total 49) submitted to:

Journal of American Chemical Society (3); Chemical Reviews (1); Journal of Physical Chemistry Letters (1); ACS Energy Letters (1); Angewandte Chemie (1); ChemSusChem (1); ACS Applied Materials & Interfaces (1); Solar Energy (1); Physical Chemistry Chemical Physics (6), Journal of Physical Chemistry C (14); New Journal of Chemistry (5); Chemical Physics Letters (2); Journal of Physical Organic Chemistry (1); Dyes & Pigments (1); RSC Advances (2); Nanomaterials (1); Journal of Photochemistry and Photobiology A (1); Spectrochimica Acta Part A (1); Synthetic Metals (2); Acta Physica Polonica (3); Molecules (1).

Evaluation of projects:

- NCN (1 – Preludium, 2016)
- MNiSW (1 – Diamentowy Grant – ocena końcowa, 2017)

10. Scientific collaboration

Before the habilitation:

International:

- Prof. Abderrazzak Douhal, Universidad de Castilla La Mancha, Toledo, Spain;
- Prof. Licheng Sun, Royal Institute of Technology, Stockholm, Sweden;
- Prof. Xichuan Yang, Dalian University of Technology, China;
- Prof. Maria Teresa Martínez, Instituto de Carboquímica, CSIC, Zaragoza, Spain;
- Prof. Hermenegildo García, Instituto de Tecnología Química CSIC-PV Valencia, Spain;
- Prof. Craig A. Grimes, Flux Photon Corporation, Raleigh North Carolina, USA;
- Prof. Miquel Moreno, Universitat Autònoma de Barcelona, Spain;
- Prof. Ron Steer, University of Saskatchewan, Saskatoon, Canada;
- Prof. Shuzi Hayase, Kyushu Institute of Technology, Japan.

National:

- Prof. Anna Grabowska, Institute of Physical Chemistry, PAN, Warszawa;
- Dr hab. Aleksander Filarowski, Faculty of Chemistry, Wroclaw University;
- Prof. Andrzej Maciejewski, Faculty of Chemistry, AMU, Poznań;
- Prof. Ryszard Naskręcki, Prof. Andrzej Dobek, Dr hab. Krzysztof Gibasiewicz Dr Jerzy Karolczak, Dr hab. Gotard Burdziński, Dr Maciej Lorenc, Faculty of Physics, AMU, Poznań.

After the habilitation: (besides PhD and Master students):

International:

- Prof. Juan A. Anta, Dr Jesús Idígoras, Dr Anna Todinova (Universidad Pablo de Olavide, Sevilla), Spain;
- Dr Ramón Tena Zaera, Dr Ivet Kosta, Dr Eneko Azaceta (CIDETEC, Parque Tecnológico de San Sebastián), Spain;
- Prof. Abderrazzak Douhal, Dr Cristina Martín, Dr Boiko Cohen, Dr Noemí Alarcos (Universidad de Castilla La Mancha, Toledo), Spain;
- Prof. Anders Hagfeldt (EPFL, Lozanne), Switzerland;
- Dr Haining Tian (KTH Royal Institute of Technology, Stockholm), Sweden;
- Dr Gustavo de Miguel (University of Cordoba), Spain.

National:

- Prof. Marek Szafrański, Dr Jerzy Karolczak, Dr hab. Jacek Kubicki, Dr hab. Gotard Burdziński, Dr Dariusz Komar (Faculty of Physics, AMU, Poznań);
- Dr hab. Błażej Gierczyk, Dr hab. Maciej Zalas (Faculty of Chemistry, AMU, Poznań);
- Dr Mariusz Jancelewicz, Dr Patryk Florczak, Dr Grzegorz Nowaczyk, Dr Emerson Coy (NanoBioMedical Centre, AMU, Poznań);
- Dr Konrad Wojciechowski, Dr Janusz Szeremeta (Saule Technologies, Wrocław).

IV. Achievements in the field of supervising and teaching of young staff and students

1. Supervisor in completed doctoral dissertations:

1) Dr Jan Sobuś
   PhD thesis title: Optimization of charge separation in organic dye-sensitized solar cells (DSSCs) with different nanostructure films and redox mediators
   Supervisor: dr hab. Marcin Ziółek
   Institution: Adam Mickiewicz University in Poznań
   Date: 22.04.2016 (thesis awarded)

2. Supervisor in ongoing doctoral dissertations:

1) Mgr inż. Adam Glinka (doctoral dissertation opened)
   PhD thesis title: Determination of charge transfer dynamics and efficiency in solar cells sensitized with silyl-anchor dyes
   Supervisor: dr hab. Marcin Ziółek
   Auxiliary supervisor: dr Mateusz Gierszewski
   Date of opening: 13.07.2018
2) Mgr inż. Iwona Grądzka (doctoral dissertation opened)
   PhD thesis title: Limitations of charge separation and transport efficiency in solar cells and water splitting systems containing ruthenium complexes
   Supervisor: dr hab. Marcin Ziółek
   Auxiliary supervisor: dr Mateusz Gierszewski
   Date of opening: 13.07.2018
3) Lic. Katarzyna Pydzińska (doctoral dissertation opened)
   PhD thesis title: Determination of charge transfer and recombination dynamics in perovskite solar cells
   Supervisor: dr hab. Marcin Ziółek
   Date of opening: 13.07.2018

Informal, partial care of PhD students:

dr Katarzyna Filipczak (supervisor prof. Andrzej Maciejewski, Faculty of Chemistry AMU): 3 mutual publications

dr Cristina Martín (supervisor prof. Abderrazzak Douhal, Universidad de Castilla-La Mancha, Toledo, Spain): 4 mutual publications

dr Jesús Idígoras (supervisor prof. Juan A. Anta, Universidad Pablo de Olavide, Sevilla, Spain): 2 mutual publications during his PhD work

3. Supervising master and bachelor theses:

Bachelor theses:

1. Maria Gieysztor, „Problem of hysteresis in perovskite solar cells", Faculty of Physics and Astronomy, University of Wrocław, defense date: 25.08.2015, supervisor: dr hab. Marcin Ziółek
2. Katarzyna Pydzińska, "Solar cell sensitized with the organic dye absorbing in the near infrared: problem with sunlight energy conversion efficiency studied by ultrafast laser spectroscopy", Faculty of Physics AMU, data obrony: 08.07.2016, supervisor: dr hab. Marcin Ziółek

Master thesis:

1. Brian Quere, „Characterization of mixed-ion perovskite solar cells prepared under different conditions", Université Rennes, project MaMaSELF, defense date 30.08.2018, supervisor: dr hab. Marcin Ziółek

4. Reviews of doctoral and habilitation dissertations

Doctoral dissertations:

1. dr Juan Manuel Ortiz Sánchez,
   „Excited state intramolecular proton transfer reactions coupled with non adiabatic processes: Electronic structure and quantum dynamical approach",
   supervisor: prof. Miquel Moreno
   Universitat Autonoma de Barcelona,
   Year: 2009
2. dr Kacper Pilarczyk,
   "Information processing in molecular-scale systems based on carbon nanostructures",
   supervisor: prof. Konrad Szaciłowski
   Academic Center of Materials and Nanotechnology of the AGH University of Science and Technology in Cracow,
   Year: 2017
3. dr Karolina Smolarek,
   "Plasmonic interactions in polymer hybrid systems for applications in optoelectronics",
   supervisor: prof. Sebastian Maćkowski
   Faculty of Physics, Astronomy and Applied Computer Science of the Nicolaus Copernicus University in Toruń,
   Year: 2017
4. dr Maciej Klein,
   „Magnetic field effects in dye-sensitized and organic solar cells",
   supervisor: prof. Waldemar Stampor
   Faculty of Technical Physics and Applied Mathematics of the Gdańsk University of Technology,
   Year: 2018
5. dr Alexander Zachary Davis Jodlowski,
   „Synthesis and characterization of hybrid perovskite and their implementation in solar cells",
   supervisors: prof. Luis Camancho Delgado, dr Gustavo de Miguel Rojas
   Departamento de Química Física y Termodinámica Aplicada, Universidad de Córdoba
   Year: 2018

Habilitation dissertations:

1. Dr Beata Łuszczyńska
   "Optimization of organic optoelectronic equipment – device structure and analysis of physical phenomena determining the performance of photodiodes"
   Łódź University of Technology
   (currently during the review)

5. Lectures, laboratories and seminars:

- lecture in English „Sunlight energy conversion" since 2017;
- classes from the module „Photovoltaics" since 2015 (lectures, seminars and laboratories);
- lecture in English „Principles of photovoltaics" in 2015;
- lecture in English „Nanomaterials in photovoltaics" in 2015;
- lecture and seminars „Nanomaterials in solar cells" in 2011-2014;
- laboratories within the Physics Laboratory I and then the Laboratory of the Basics of Physical Experiment;
- laboratories within the framework of the Physical Microcomputer Laboratory, including English classes for Erasmus students;
- classes of LabView programming;
- classes „ Introduction to computer science and digital electronics" (until 2009);
- classes from femtosecond transient absorption for Erasmus students of SoftMat Control „Soft Matter, evolution, control of complexity and challenges" program im 2012.

Moreover:

- preparation of laboratory exercises for students in the LabView environment: "The use of serial communication for temperature control", "Magnetic hysteresis test" and "Rotary motion; moment of momentum and momentum "as part of the Physical Microcomputer Laboratory at the Faculty of Physics AMU in the academic year 2004/2005 and 2005/2006;
- development of 5 exercises of the Physical Microcomputer Laboratory in the field of electricity and magnetism in English for Erasmus students in 2015.

V. Organizational activity and popularizing science:

Organizational activity:

- organization of „Physics of Advanced Materials for Energy Processing” (PAMEP) graduate studies in the Faculty of Physics AMU in 2018 (www.pamep.home.amu.edu.pl);
- organization of photovoltaic seminars at the Faculty of Physics of Adam Mickiewicz University (24 seminars in the period 2016-2018 , www.solencon.home.amu.edu.pl/seminars.html);
- a secretary of the Council of the Faculty of Physics AMU in 2012-2013;
- a member of the elected section of the Council of the Faculty of Physics AMU for the 2016-2020 term;
- participation in recruitment committees at the Faculty of Physics AMU in the years 2006-2007, 2011-2012 and 2018;
- a secretary of two habilitation committees (Dr. Rafał Luchowski, PhD Sławomir Mamica)
- a member of three doctoral commissions, Faculty of Physics, AMU
- a member of the staff and structure committee, Faculty of Physics, AMU
- chairman during conferences
  (EMN (Energy Materials Nanotechnology) Meeting, Istanbul, Turkey, 1-4.07.2015;
  E-MRS Fall Meeting, Warsaw, 19-22.09.2016;
  NanoTech Poland 2018, Poznań, 6-9.06.2018);
- participation in the organization of the conference XXIV International Conference on Photochemistry, Toledo, Spain 19-24.07.2009.

Activity in popularizing science:

- presentation of photovoltaic research to one of the episodes of the film series „From University Life” (2015/7), realized by the AMU Film Studio in 2015 (http://usf.amu.edu.pl/filmoteka/z-ycia-uniwersytetu/z-ycia-uniwersytetu-odcinek-171);
- participation in the film "Clean Energy - Sun" on solar cells, produced by SIDMA films (directed by Janusz Sidor) in 2012 (https://www.youtube.com/watch?v=-IYgGao8aqE&version=3&hl=pl%5FPL);

- participation in the program "Newton was also a student - an academic support program for schools" in the academic year 2011/2012 (magnetic hysteresis exercises) and 2012/2013 (exercises in optics and lasers);
- conducting a dozen or so demonstrations for elementary, junior and high school students from the action of an argon laser (among others within the Open Lectures at the Faculty of Physics AMU) in the years 2003-2012;
- presentation of the expercise "Determining the speed of light in optical fiber" during the Festival of Science and Art at the Faculty of Physics AMU in 2004.

VI. Awards

- scholarship of the Minister of National Education for the academic year 1998/99,
- national scholarship of the Foundation for Polish Science for young scientists in 2002 and 2003,
- gratification of the Vice-Rector of AMU in 2005,
- third degree Rector's Team Award in 2006,
- second degree Rector's Team Award in 2007,
- individual awards of the 3rd degree of the Rector of the AMU in 2013,
- individual awards of the 3rd degree of the Rector of the AMU in 2016,
- special prize of the Rector of Adam Mickiewicz University for outstanding publishing output for 2017,
- first degree Rector's Team Award in 2018.

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(signature of the candidate)