Dr Michał Bystrzejewski

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Department of Chemistry

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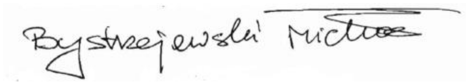
02-093 Warszawa

Summary of scientific achievements in relation to habilitation procedure

Warsaw, May 2014

1. **Name and surname: MICHAŁ BYSTRZEJEWSKI**
2. **Education**

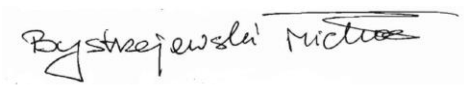
Oct. 2004 r. – May 2008 r.	University of Warsaw Department of Chemistry PhD studies: Synthesis of carbon nanotubes from carbon materials of various graphitization degree Supervisor: prof. dr hab. Hubert Lange PhD thesis with honours
Oct. 1999 r - May 2004 r.	University of Warsaw Department of Chemistry MSc studies: Synthesis of carbon nanocapsules from graphite and magnetic materials in electric arc Supervisor: prof. dr hab. Hubert Lange



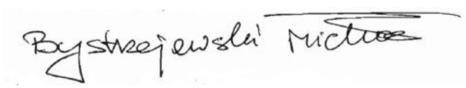
3. **Information on academic employment:**

Since October 2008 – University of Warsaw, Department of chemistry

Position: assistant professor



4. **Identification of achievement pursuant to Art.16(2) of the Act of 14 March 2003 on scientific degrees and artistic titles (Journal of Laws no. 65, item 595 as amended) setting the basis for the habilitation proceedings**
    a) **Title of scientific achievement: Synthesis, properties and applications of selected hybrid magnetic carbon nanomaterials**



b) List of scientific publications setting the basis for habilitation proceedings:

[H1] **M. Bystrzejewski**, O. Łabędź, W. Kaszuwara, A. Huczko, H. Lange, *Controlling the diameter and magnetic properties of carbon-encapsulated iron nanoparticles produced by carbon arc discharge*. Powder Technology 2013, 246, 7-15. **IF(2012)=2.024**

Author's contribution = 70%, corresponding author; citations:1

I have stated the scientific problem, planned the experimental works, written the whole manuscript, analyzed the results and performed the revised version of the manuscript.

[H2] **M. Bystrzejewski**, O. Łabędź, H. Lange, *Diagnostics of carbon arc plasma under formation of carbon-encapsulated iron nanoparticles by emission and absorption spectroscopy*. Journal of Physics D: Applied Physics 2013, 46, 355501 (1-10). **IF(2012)=2.528**

Author's contribution = 75%, corresponding author; citations:0

I have stated the scientific problem, planned the experimental, written the whole manuscript, analyzed the results and performed the revised version of the manuscript.

[H3] **M. Bystrzejewski**, Z. Karoly, J. Szepvolgyi, W. Kaszuwara, A. Huczko, H. Lange. *Continuous synthesis of carbon encapsulated magnetic nanoparticles with a minimum production of amorphous carbon.* Carbon 2009, 47, 2040-2048. **IF(2009)=4.504**

Author's contribution = 65%, corresponding author; citations:19

I have stated the scientific problem, planned the experimental works, written the whole manuscript, analyzed the results and performed the revised version of the manuscript.

[H4] **M. Bystrzejewski**, Z. Karoly, J. Szepvolgyi, A. Huczko, H. Lange. *Continuous synthesis of controlled size carbon-encapsulated iron nanoparticles*. Materials Research Bulletin, 2011, 46, 2408-2417. **IF(2011)=2.105**

Author's contribution = 70%, corresponding author; citations:2

I have stated the scientific problem, planned the experimental works, written the manuscript (95%), analyzed the results (90%) and performed the revised version of the manuscript.

[H5] **M. Bystrzejewski**, M. Szala, W. Kiciński, W. Kaszuwara, M.H. Rummeli, T. Gemming, A Huczko. *Self-sustaining high-temperature synthesis of carbon-encapsulated nanoparticles from organic and inorganic metal precursors.* New Carbon Materials 2010, 25, 81-88. **IF(2010)=0.888**

Author's contribution = 45%, corresponding author; citations:0

I have partially stated the scientific problem, planned and performed the experimental works (60%), written the manuscript (80%), analyzed the results (60%) and performed the revised version of the manuscript.

[H6] **M. Bystrzejewski**, H. Lange, A. Huczko, P. Baranowski , H.W. Hubers, T. Gemming, T. Picher, B. Buchner, M. H. Rümmeli. *One-step catalyst-free generation of carbon nanospheres via laser-induced pyrolysis of anthracene*. Journal of Solid State Chemistry 2008, 181, 2796-2803. **IF(2008)=1.910**
Author's contribution = 55%, corresponding author; citations:17
I have stated the scientific problem, planned and performed the experimental works (80%), written the manuscript (80%), analyzed the results and performed the revised version of the manuscript.

[H7] **M. Bystrzejewski**, H.W. Hubers, A. Huczko, T. Gemming, B. Buchner, M.H. Rummeli. *Bulk synthesis of carbon nanocapsules and nanotubes containing magnetic nanoparticles via low energy laser pyrolysis of ferrocene*. Materials Letters 2009, 63, 1767-1770. **IF(2009)=1.940**
Author's contribution = 70%, corresponding author; citations:2
I have stated the scientific problem, planned and performed the experimental works, written the whole manuscript, analyzed the results and performed the revised version of the manuscript.

[H8] **M. Bystrzejewski**, R. Klingeler, T. Gemming, B. Bucher, M.H. Rummeli. *Low temperature synthesis of carbon-encapsulated iron nanoparticles: a critical evaluation of yield and selectivity.* Nanotechnology 2011, 22, 315606. **IF(2011)=3.979**
Author's contribution = 70%, corresponding author; citations:4
I have stated the scientific problem, planned and performed the experimental works, written the manuscript (90%), analyzed the results and performed the revised version of the manuscript.

[H9] **M. Bystrzejewski**. *Synthesis of carbon-encapsulated iron nanoparticles via solid state reduction of iron oxide nanoparticles*. Journal of Solid State Chemistry 2011, 184, 1492-1498. **IF(2011)=2.159**
Author's contribution = 100%, corresponding author; ; citations:4
I have stated the scientific problem, planned and performed the experimental works, written the whole manuscript, analyzed the results and performed the revised version of the manuscript.

[H10] **M. Bystrzejewski**, A. Grabias, J. Borysiuk, A. Huczko, H. Lange. *Mőssbauer spectroscopy of carbon-encapsulated magnetic nanoparticles obtained by different routes*. Journal of Applied Physics 2008, 104, 54307. **IF(2008)=2.201**

Author's contribution = 40%, corresponding author; citations:6

I have stated the scientific problem, planned and performed the experimental works (40%), written the manuscript (50%), analyzed the results (60%) and performed the revised version of the manuscript.

[H11] **M. Bystrzejewski**, A. Grabias. *Tailoring phase composition in carbon-encapsulated iron nanoparticles*. Materials Characterization, 2011, 62, 152-156. **IF(2011)=1.572**

Author's contribution = 60%, corresponding author; citations:2

I have stated the scientific problem, planned and performed the experimental works (50%), written the manuscript (70%), analyzed the results (50%) and performed the revised version of the manuscript.

[H12] **M. Bystrzejewski**, K. Pyrzyńska, A. Huczko, H. Lange. *Carbon-encapsulated magnetic nanoparticles as separable and mobile sorbents of heavy metal ions from aqueous solutions*. Carbon 2009, 47, 1201-1204. **IF(2009)=4.504**

Author's contribution = 50%, corresponding author; citations:36

I have stated the scientific problem, planned and performed the experimental works (50%), written the manuscript (50%), analyzed the results (70%) and performed the revised version of the manuscript.

[H13] K. Pyrzyńska, **M. Bystrzejewski**. *Comparative studies of heavy metal ions adsorption onto activated carbon, carbon nanotubes and carbon-encapsulated magnetic nanoparticles.* Colloids&Surfaces A 2010, 362, 102-109. **IF(2010)=2.130**

Author's contribution = 50%, corresponding author; citations:47

I have stated the scientific problem, planned and performed the experimental works (40%), written the manuscript (70%), analyzed the results (65%) and performed the revised version of the manuscript.

[H14] **M. Bystrzejewski**, K. Pyrzyńska. *Kinetics of copper ions sorption onto activated carbon, carbon nanotubes and carbon-encapsulated magnetic nanoparticles*. Colloids & Surfaces A 2011, 377, 402-408. **IF(2011)=2.236**

Author's contribution = 60%, corresponding author; citations:11

I have stated the scientific problem, planned and performed the experimental works (40%), written the manuscript (80%), analyzed the results (90%) and performed the revised version of the manuscript.

[H15] **M. Bystrzejewski**, K. Pyrzyńska. *Enhancing the efficiency of Au adsorption onto activated carbon and carbon nanomaterials*. Material Chemistry and Physics 2013, 141, 454-460. **IF(2012)=2.072**

Author's contribution = 70%, corresponding author; citations:0

I have stated the scientific problem, planned and performed the experimental works (40%), written the manuscript (90%), analyzed the results (70%) and performed the revised version of the manuscript.

[H16] A.M. Nowicka, A. Kowalczyk, **M. Bystrzejewski**, M. Donten, Z. *Stojek Carbon-encapsulated iron nanoparticles used to generate magnetic field and to enhance substrate transport at electrode surface*. Electrochemistry Communications 2012, 20, 4-6. **IF(2012)=4.425**

Author's contribution = 20%; citations:1

I have synthesized and purified carbon encapsulates, measured the distribution of magnetic field strength, written a part of the manuscript (20%) and analyzed the results (20%).

[H17] **M. Bystrzejewski**. Magnetic composites of carbon materials: synthesis, structure and applications. Przemysł Chemiczny 2011, 90, 399-405. **IF(2011)=0.414**

Author's contribution = 100%; citations:1

I have stated the scientific problem, searched the cited references and written the whole manuscript. I estimate my contribution to be 100%.

[H18] A. Huczko, **M. Bystrzejewski**, H, Lange, P. Baranowski, "Formation and Characterization of Carbon and Ceramic Nanostructures" in: Physical Properties of Ceramic and Carbon Nanoscale Structures. Ed. S. Bellucci, Springer-Verlag, Berlin Heidelberg 2011 (1-44).

I have written the hole section on carbon-encapsulated magnetic nanoparticles. I estimate my contribution to be 33%.

Total impact factor of papers listed above according to the list from Journal Citation Reports: 41.591

Bystrzejewski Michał

c) Summary of the scientific goals and major results of presented publications

My research and teaching activities are linked with the Department of Chemistry, University of Warsaw. My MSc thesis was realized under the supervision of prof. Hubert Lange. The thesis was on synthesis of magnetic carbon nanocapsules fabricated via carbon arc discharge route. During the realization of the MSc thesis I interested in plasma chemistry as an unique tool for the synthesis of various (nano)materials, which cannot be produced using conventional techniques. After obtaining the MsC diploma I started PhD studies. My supervisor was also prof. Hubert Lange.

The PhD thesis comprised the problem of the influence of graphitization degree of carbon electrodes on the formation of single-wall carbon nanotubes. The thesis has been defended in May 2008 (with honors). During PhD studies I have been staying for 3 months at the Institute for Solid State and Materials Research in Dresden. The stay in this institute enforced my knowledge and experience in pulsed and continuous laser systems, vacuum technology, transmission electron microscopy and spectroscopy of solid state matter. The collaboration with the scientists from Dresden has been a specific catalyst and triggered new scientific ideas and challenges. During PhD studies I have also published (with collaboration of prof. Andrzej Huczko) a book "Fulereny 20 lat później", which is a summary of 20-year research on physics and chemistry of fullerenes. The book was published in 2007 and consists of 300 pages with more than 2700 cited references.

Just after the public defense of PhD thesis I was hired as an assistant professor at the Dept of Chemistry at University of Warsaw. I have focused my research activity on hybrid magnetic carbon nanomaterials, especially on carbon-encapsulated magnetic nanoparticles. In general, magnetic hybrid carbon nanomaterials include a broad class of composite materials, in which the magnetic phase is embedded in carbon phase. This class presumably involves the (i) composites of graphene and ferrite nanoparticles[1], (ii) composites of activated carbon and magnetic nanoparticles[2] and (iii) carbon-encapsulated magnetic nanoparticles (CEMNPs)[3]. The latter ones have been discovered in 1993[3] during intensive research on formation of fullerenes and carbon nanotubes in carbon arc discharge. CEMNPs are core-shell type nanomaterials, in which the core is composed of metal or metal carbide crystallite. The typical diameter of the core is between 5 nm and 100 nm. The core is covered by a thin (1-10 nm in thickness) and protective layer, which comprises of curved graphene layers. The carbon coating protects the encapsulated nanoparticle against corrosion, oxidation and agglomeration. Another benefit coming from the presence of the carbon coating is the ability for its covalent and non-covalent functionalization. The functionalization opens a way for controllable and

[1] X. Yang et al., J. Mater. Chem. A 2013, 1, 8332
[2] Z.C. Kadirova et al., Appl. Surf. Sci. 2013, 284, 72
[3] R.S. Ruoff et al., Science 1993, 259, 346

programmable modification of the surface properties of CEMNPs and creation of new hybrid materials with new and predictable functionalities. The encapsulated magnetic nanoparticles perfectly preserve their physical and chemical properties. If they are small enough (smaller than critical magnetic domain size), they can even exhibit the so-called superparamagnetic behavior. Moreover, carbon-encapsulated magnetic nanoparticles may find new and prospective applications, e.g. as mobile platforms for catalysis, mobile sorbents, and in various biomedical applications (magnetothermia, molecular imaging of cancer, drug and gene delivery).

The papers which are included in this summary of achievements are divided into three sub-groups: (i) publications on synthesis, (ii) papers on physical and chemical properties and (iii) publications focused on potent applications.

The main goal of my research included:

- Development of optimal synthesis method of carbon-encapsulated magnetic nanoparticles with a critical evaluation of results presented in published papers by other groups
- Spectroscopic diagnostics of carbon arc plasma during formation of carbon-encapsulated magnetic nanoparticles
- Evaluation of critical parameters which tailor the diameter distribution, phase composition and magnetic properties of carbon-encapsulated iron nanoparticles
- Studies of sorption properties of carbon-encapsulated iron nanoparticles towards heavy metal ions

The carbon arc discharge is one of the methods, which are frequently used in fabrication of carbon-encapsulated magnetic nanoparticles. In the paper [H1] I have performed systematic studies on the influence on anode chemical composition (C/Fe) on the synthesis yield of CEMNPs, discharge operational parameters, morphology, diameter distribution, graphitization degree and magnetic properties. The experimental works were conducted on two types of electrodes, namely homo- and heterogeneous. I have shown that the anode composition is the solely parameter that exclusively determines the process selectivity, graphitization degree and magnetic properties of carbon-encapsulated iron nanoparticles. The discharge current and the type of the anode (homo- vs. heterogeneous) slightly influenced these parameters. I have also demonstrated that the qualitative phase composition does depend neither the delivered power nor the anode composition. Furthermore, I have shown that carbon arc discharge is a fully reproducible method for fabrication of

CEMNPs and I have determined the conditions at which carbon encapsulates are formed with the highest yield and largest selectivity.

I have expanded the parametric studies presented in [H1] to additional diagnostics of the arc discharge zone, i.e. I have determined the distributions of tempature, C_2 radical column density and carbon vapor pressure [H2]. I have applied two alternative approaches of optical spectroscopy, i.e. emission and absorption techniques. A such detailed analysis of the carbon arc zone has never been described in the literature. The absorption approach allows to investigate the plasma constituents at their ground electronic levels, whilst the emission spectroscopy is limited to the excited species only. In the first part of work [H2] I have developed a model which simulates the emission and absorption spectra assuming some realistic distributions of temperature and C_2 density. Then, I have verified the model to confirm whether the computation procedure reproduces the initial theoretical radial distributions of temperature and C_2 column density. The results showed that the initial distributions are reproduced with the goodness better than 90%. Next, the computation model has been adapted to treat the experimental data. I have shown that the temperature of C_2 radical is substantially different for the non-excited and excited state (the observed difference was between 600 and 1000 K). The temperature of Fe(I) atoms also exceeded the temperature of C_2 radicals, approximately more than 1000 K. The differences were also found for the column density distributions of C_2 radical, i.e. the column density for the radical in the ground level was ca. two times lower in comparison to the column density for the excited radical. This difference was mainly due to Mie scattering of radiated light on the condensing solid particles, which were present on the optical axis. The difference in C_2 and Fe(I) temperature originated from the non-equilibrium between the plasma constituents. The estimated carbon vapor and Fe(I) pressure perfectly correlated with the encapsulation yield, as determined in work [H1].

The carbon arc discharge is a selective and high yield method for the fabrication of carbon-encapsulated magnetic nanoparticles. However, this is a periodic process and the available mass of the raw product (in a single run) is a derivative on the anode length. In order to eliminate this drawback one can apply a thermal plasma jet, in which temperature is much higher (even 20 000 K) than in the case of carbon arc. The thermal plasma jet approach also enables the continuous feeding of starting materials (i.e. precursor of metal and carbon) and continuous recovery of products. The main limitation of the thermal plasma jet is a short resident time of introduced particles in the high temperature zone. The introduced material falls down quite quickly and may be not vaporized. This is especially important in the case when graphite is used as a carbon precursor. The ultra-fine graphite powders (with the size below 10 microns) vaporize slowly and pass through the plasma flame with the nearly unchanged morphology[4]. On the other hand, the use of hydrocarbons (e.g. acetylene) activates the channels in which amorphous carbon is formed[5]. In fact, the elimination of amorphous carbon is not problematic, however, it requires the post-process treatment. The goal which was stated in work [H3] involved the development of a synthesis method, in which the amorphous carbon is eliminated during the one-step synthesis of CEMNPs. To realize this objective, I used the oxygen-containing precursors or introduced the molecular oxygen to the plasma gas. I have demonstrated that the presence of oxygen substantially decreased the amount of amorphous carbon. The highest reduction of amorphous carbon was obtained when ethanol was used as a carbon precursor. I have shown that the efficiency of elimination of amorphous does only depend on the amount of oxygen in the plasma environment. Moreover, I have proved that the presence of oxygen does not lead to formation of iron oxide phases.

In the next work which is related to thermal plasma [H4] I have considered a problem on the controlling the diameter of carbon-encapsulated iron nanoparticles. On the basis of optimal conditions derived from [H3] I have studied the influence of the grain size of the starting Fe powder on the synthesis of CEMNPs. I have shown that the plasma processing of ethanol and Fe powder of the lowest grain size results in carbon-encapsulated iron nanoparticles with broad diameter distribution (10-100 nm). Interestingly, the processing of Fe powders having larger grains drastically reduced the diameter of CEMNPs and narrowed their distribution to be between 5 and 10 nm. I have proved that the observed observations are the effect of distinct vaporization rates of the starting Fe powder in the plasma jet. I have also underlined that thermal properties of the plasma gas influence the encapsulation yield. As for example, the addition of light noble gases (e.g He) of high thermal conductivity substantially improved the encapsulation yield.

The plasma methods are efficient techniques that may be used for fabrication of CEINs with high selectivity and high yield. However, they are reflected by high energy consumption and sophisticated construction of plasma torches and reactors. I have conducted some trials to verify whether the use of combustion synthesis can yield carbon-encapsulated magnetic nanoparticles. Combustion synthesis is a fast and self-sustaining reaction of a highly exothermic character. The released heat during the reaction reaches even 4MJ/kg (in refer to the total mass of the starting reactants). It provides to a substantial mean mass temperature, which is between 1800 and 2000 K [6].

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[4] **M. Bystrzejewski**, H. Lange, A. Huczko, Z. Karoly, L. Gal. *RF plasma synthesis of carbon encapsulates*. Polish Journal of Applied Chemistry 2005, 49, 23-31.

[5] **M. Bystrzejewski**, A. Huczko, H. Lange, P. Baranowski, G. Soucy, G.Cota-Sanchez, J. Szczytko, A, Twardowski. *Large Scale Synthesis of Carbon Encapsulated Magnetic Nanoparticles.* Nanotechnology 2007, 18, 145608.

[6] A. Huczko, M .Osica, A. Rutkowska, **M. Bystrzejewski**, H. Lange, S. Cudziło. *A self–assembly SHS approach to form silicon carbide nanofibres*. Journal of Physics Condensed Matter 2007, 19, 395022.

First, I have conducted some exploratory research to find a system which yields the nanostructural carbon phases. I have studied the sodium azide – hexachlorobenzene system, which resulted in spherical hollow carbon nanoparticles[7],[8]. In works[9],[10] I have realized that the addition of ultra-fine metal powders (Fe, Co, Ni, $Fe_{14}Nd_2B$) to NaN_3-C_6Cl_6 mixture results in formation of product containing few amounts of carbon-encapsulated magnetic nanoparticles. The resultant encapsulation yield was low, because the released amount of heat was not enough to vaporize the starting metal precursor. have suggested that the process of surface vaporization of the starting metallic grains can be additionally supported by the in-situ formed shock wave. A substantial increase of encapsulation yield was realized when the metallic precursor was in a form of metal-organic compound [H5]. I have also proved that the graphitization degree is perfectly correlated with the heat released during the combustion.

During my stay at the Institute for Solid State and Materials Research in Dresden I have been using a continuous CO_2 laser beam as an efficient source of heat and verified whether its application may be used to synthesis of carbon-encapsulated magnetic nanoparticles. The laser beam of the power of 30 W can heat the target of 10 mm in diameter up to 1300-1600 K. In the first step of research I focused on the laser decomposition of a single carbon precursor, i.e. anthracene [H6]. The laser pyrolysis of this compound yielded low graphitized carbon nanospheres with the diameter between 100 and 400 nm. The exchange of anthracene to ferrocene resulted in formation of a mixture of magnetic carbon nanocapsules and multi-wall carbon nanotubes [H7]. Moreover, I have demonstrated that the encapsulation yield correlates with the pressure of the buffer gas.

The review of the literature shows that carbon-encapsulated magnetic nanoparticles can be synthesized in typical laboratory ovens at temperature below 1500 K. I have performed the studies which critically verified the already published data. I have focused on two synthesis routes: (i) thermal pyrolysis of a mixture containing polymer and metalloorganic compound, and (ii) carbochemical reduction of nanosized iron oxide. In the first case, I have shown that the pyrolysis of

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[7] **M. Bystrzejewski**, A. Huczko, H. Lange, S. Cudziło, W. Kiciński. *Combustion synthesis route to carbon-encapsulated iron nanoparticles*. Diamond and Related Materials 2007, 16, 225-228.

[8] **M. Bystrzejewski**, M.H. Rümmeli, T. Gemming, H. Lange, A. Huczko. *Catalyst-free synthesis of onion-like carbon nanoparticles*. New Carbon Materials 2010, 25, 1-8.

[9] **M. Bystrzejewski**, A. Huczko, H. Lange, P. Baranowski, , W. Kaszuwara, S. Cudziło, E. Kowalska, M.H. Rummeli, T. Gemming. *Carbon-encapsulated magnetic nanoparticles spontaneously formed by thermolysis route*. Fullerenes, Nanotubes and Carbon Nanostructures 2008, 16, 217-230.

[10] [10] **M. Bystrzejewski**, A. Huczko, M. Soszyński, S. Cudziło, W. Kaszuwara, M.H. Rummeli, T. Gemming, H. Lange. *An easy one-step route to carbon-encapsulated magnetic nanoparticles*. Fullerenes, Nanotubes and Carbon Nanostructures 2009, 17, 600-615.

a mixture of poly(vinyl alcohol) and iron citrate presumably results in microcrystalline Fe and graphite crystals [H8]. Moreover, I have proven that the encapsulation yield is inversely proportional to the content of Fe precursor in the initial mixture. I have also demonstrated that the pyrolysis of the mixture can lead to nanocomposites containing some amount of low graphitized microporous carbon phase. In work [H9] I have performed a critical assessment to the previous results published by H. Tokoro et al. from Japan. They have showed that carbon-encapsulated iron nanoparticles with superior magnetic properties can be very effectively formed during carbochemical reduction of nanosized iron oxide by carbon black. My research included not only the repetition of Tokoro's tests, but I have also adapted the new experiments in which I used two other carbon reducers, i.e. hollow carbon nanoparticles and ultra-fine graphite powder. I have proven that the carbochemical reduction of iron oxide nanoparticles at 1273 K primarily results in cubic and spherical shape Fe microparticles, which are mixed with the grains of the initial carbon reducer. The content of CEMNPs in products did not exceed a few wt. %. I have also shown that magnetic properties of CEMNPs reported by the Japanese group were overestimated by at least of two orders of magnitude. Moreover, I have demonstrated that the encapsulation yield can be improved when the process temperature is increased to 1473 K.

The next papers were focused on the phase composition of carbon-encapsulated iron nanoparticles. The thermodynamic predictions clearly indicate that two Fe-bearing phase can be encapsulated: bcc Fe (alpha iron) and Fe_3C (iron carbide). The powder X-ray diffraction is a method, which is routinely used for estimating the qualitative phase composition. In the case of nanostructural metallic phases based on Fe, this method gives the results which are ambiguous and hard to interpretation, because the reflections of the respective phases are broadened and frequently overlapped. In order to make the identification of phase composition more convenient the spectroscopy of Mossbauer effect was applied (see [H10] and paper[11]). I have proven that the thermodynamically unstable fcc Fe (gamma iron) exist in the encapsulated form in CEMNPs, which are fabricated by any of synthesis techniques. Its relative content can reach even 43%. I have realized that the presence of this metastable phase does not depend on the synthesis route of carbon encapsulates. The fcc Fe was present in the products obtained both via carbon arc and thermal plasma jet as well as via combustion synthesis. The matter of the presence of fcc Fe was also mentioned in paper [H1]. In this paper I have demonstrated a facile way for semi-quantitative analysis of phase composition. This approach is based on the normalization of the saturation

[11] J. Borysiuk, A. Grabias, J. Szczytko, **M. Bystrzejewski**, A. Twardowski, H. Lange. *Structure and magnetic properties of carbon encapsulated Fe nanoparticles obtained by arc plasma and combustion synthesis.* Carbon 2008, 46, 1693-1701.

magnetization by the total Fe content and compare the obtained output with a linear combination of contribution of two ferromagnetic phases, i.e. bcc Fe and Fe_3C.

The presence of gamma iron is highly undesirable, because this phase is paramagnetic and its presence leads to worsening the magnetic performance, especially to lower saturation magnetization. As a result of that, the CEMNPs which contain fcc Fe exhibit weaker attraction to external magnetic field. In work [H11], which corresponds to [H3], I have proven that the presence of oxygen eliminates the amorphous carbon and simultaneously influence the quantitative phase composition. The presence of oxygen shifted the equilibrium towards the most desired phase, i.e. bcc Fe, and diminished the amounts of iron carbide and gamma iron. In the same work I have also demonstrated a method, which allows to calculate the magnetic response from the chemical composition and the results from the Mossbauer spectra. The simulated magnetic response was in agreement with the experimental data obtained from vibrating magnetometer with the goodness between 75 and 99%.

The problem of controlling of phase composition in carbon-encapsulated iron nanoparticles has been also described in my recent paper, which is not included in the Summary of scientific achievements in relation to habilitation procedure[12]. I have stated a hypothesis that the inclusion of ferrite stabilizing element (aluminum) in the iron-carbon system should minimize the content of austenite in carbon-encapsulated iron nanoparticles synthesized via carbon arc route. I have performed a systematic study in which the C-Fe anodes were doped with various amounts of Al. The influence of Al on synthesis yield, morphology and magnetic properties of CEMNPs was studied. The results were in total disagreement with thermodynamic predictions. The inclusion of Al resulted in CEMNPs with the increased content of austenite and poorer magnetic performance.

In 2009 r. I have obtained a 2-year grant from Ministry of Science and Higher Education for the realization of the research project on synthesis and applications of carbon-encapsulated magnetic nanoparticles in heavy metals adsorption. The project was aimed on the development of a mobile sorbent based on carbon-encapsulated iron nanoparticles. Mobile sorbents have a significance advantage in comparison to the conventional sorbents (e.g. activated carbons, zeolites, silica). Namely, their separation from the environment (e.g solution) is extremely easy when one applies the external magnetic field. In the case of conventional sorbents, the separation requires the use of time consuming unit operations, e.g. filtration or centrifugation. The sorption of heavy metal ions onto carbon materials does not require, contrary to the common opinion, highly developed

[12] O. Łabędź, A. Grabias, W. Kaszuwara, **M. Bystrzejewski**, *Influence of Al on synthesis and properties of carbon-encapsulated iron nanoparticles.* Journal of Alloys and Compounds, 2014, 603, 230-238.

porosity and large corresponding surface area. The sorption mechanism of typical heavy metal ions (e.g. Fe, Co, Ni, Cu) includes the electrostatic binding of a metal cation to the negatively charged surface of a carbon sorbent. The negative charge comes from the deprotonation of surface acidic groups. Typically, in order to introduce the surface functional groups, a carbon material is subjected to nitric acid treatment. It leads to formation of various surface functionalities, e.g. carboxylic, lactonic and phenolic groups. In paper [H12] I have described the preliminary results describing the sorption potential of carbon-encapsulated magnetic nanoparticles towards to Cu(II), Co(II) and Cd(II). I have demonstrated that CEMNPs effectively adsorb ions of these metals at a broad range of pH. The high sorption efficiency was found both for surface oxidized and non-oxidized carbon encapsulates. I have also shown that the sorption efficiency of carbon-encapsulated magnetic nanoparticles exceeds the performance of multi-wall carbon nanotubes. In work [H13] I have carried out the systematic comparative studies of sorption of Cu(II) and Co(II) onto three carbon materials: magnetic carbon encapsulates, multi-wall carbon nanotubes and activated carbon. I have shown that the sorption performance of nanotubes and encapsulates is much better in comparison to activated carbon. Beside the similar content of surface functional groups in all these carbon-based sorbent, the sorption capacity of encapsulates and nanotubes was a few times higher than the sorption capacity of activated carbon. This effect originated from different surface charge density. In the case of encapsulates and nanotubes, due to low specific surface area, the surface functional groups were distributed more compactly and this effect resulted in higher surface charge density.

The next publication [H14] was focused on the sorption kinetics studies of Cu(II) onto three carbon-based sorbents, namely carbon-encapsulated magnetic nanoparticles, multi-wall carbon nanotubes and activated carbon. The sorption kinetics was studied at acidic and basic conditions. I have shown that commonly used models (the so-called pseudo first- and second-order) are not suitable for description the experimental kinetic data. Using the Elovich model I have proven that in the case of basic pH the sorption occurs faster for carbon encapsulates and nanotubes in comparison to activated carbon. I have also demonstrated that sorption kinetics in the case of carbon encapsulates and nanotubes is primarily limited by surface film diffusion. In the case of activated carbon the sorption rate was mainly limited by intraparticle diffusion.

The last work devoted to the sorption processes was on the removal of $AuCl_4^-$ from aqueous solutions [H15]. I have performed the comparative studies on the removal of gold chlorocomplex ion using four types of carbon-based sorbents: carbon-encpasulated iron nanoparticles, multi-wall carbon nanotubes, activated carbon and carbon black. I have shown that the ion uptake for the non-oxidized sorbent is primarily related with the graphitization degree and textural properties. I have demonstrated that a facile surface oxidation in nitric acid results in a two-fold increase of removal efficiency. I have also proven that the sorption of $AuCl_4^-$ causes partial and very discrete perforation of carbon coatings in CEMNPs.

In 2011 r. I was awarded by the Ministry of Science and Higher Education and I got a three-year stipend (2011-2014) for the best young scientists.

I have published a recent work [H16] with collaboration with a group of prof. Zbigniew Stojek (Dept of Chemistry, University of Warsaw). We have shown that the modification of glassy carbon electrode with carbon-encapsulated iron nanoparticles leads to interesting electro-catalytic effects. This was exemplified by a reversible reduction/oxidation process of a water soluble derivative of ferrocene studied by voltammetry. The voltammetric peaks intensity was substantially increased (even of 165%) when the low external magnetic field was applied (below 100 mT). This catalytic effect was directly related to faster transport of this redox probe to the surface of the modified electrode. The paramagnetic nature of the probe enhanced its interactions with the magnetic moment in CEMNPs generated by external permanent magnet. Another interesting effect was observed in work[13] in which the electroreduction of oxygen on the glassy carbon electrode modified with CEMNPs was investigated. It has been shown, that the presence of CEMNPs on the electrode surface shifts the reduction potential of ca. 250 mV towards more positive potentials (without external magnetic field). The use of external magnetic field caused more than 2-fold increase of the reduction peak current. It has been also demonstrated in the same publication that it is possible to obtain a composite electrode glassy carbon-CEMNPs-laccase. In this, the applying the external magnetic field lead to an increase of reduction current by the factor 1.8. These results clearly indicate that carbon-encapsulated magnetic nanoparticles have high applicative potential and can be used as modifiers, which catalyze various electrochemical processes.

I have published two review publications on carbon-encapsulated magnetic nanoparticles. The first work [H17] is a comprehensive report on mobile sorbents based on magnetic composites of activated carbons. I have presented the methods of synthesis of such composites of various porosity, i.e both micro- and mesoporous. In that paper I have also included a chapter on sorption performance of CEMNPs. The work [H18], which was published as a book by Springer publishing house, contains a chapter devoted to synthesis and properties of carbon-encapsulated magnetic nanoparticles.

[13] A.M. Nowicka, A. Kowalczyk, M. Donten, M.L. Donten, **M. Bystrzejewski**, Z. Stojek. *Carbon-encapsulated iron nanoparticles as ferromagnetic matrix for oxygen reduction in absence and presence of immobilized laccase*. Electrochimica Acta, 2014, 126, 115-121.

Summary of the most important achievements related to the publications described above:

- I have proven that the carbon arc discharge route is reproducible, selective and efficient route to synthesize carbon-encapsulated magnetic nanoparticles
- I have demonstrated that Fe content in the anode is a solely parameter which determines the diameter distribution and magnetic properties of carbon-encapsulated magnetic nanoparticles
- I have performed detailed diagnostics of carbon arc plasma by emission and absorption spectroscopy and found a clear correlation between the synthesis yield of carbon-encapsulated magnetic nanoparticles and quantitative composition of carbon arc plasma
- I have proven that the inclusion of oxygen significantly improves the selectivity of synthesis of carbon-encapsulated magnetic nanoparticles obtained in thermal plasma jet
- I have shown that diameter distribution of carbon-encapsulated magnetic nanoparticles synthesized in thermal plasma jet is controlled by the grain size of starting metal precursor
- I have demonstrated that combustion synthesis and laser pyrolysis can be used to synthesize carbon-encapsulated magnetic nanoparticles, however, the yield and selectivity is poor
- I have proven that the so-called low temperature synthesis routes of carbon-encapsulated magnetic nanoparticles primarily result in formation of micro-sized Fe particles and graphitic structures
- I have shown that the sorption efficiency of heavy metal cations onto carbon-encapsulated iron nanoparticles is a derivative of the surface charge density
- I have demonstrated that sorption kinetics of Cu(II) onto carbon-encapsulated iron nanoparticles is limited by film diffusion
- I have evidenced that oxidation of carbon-encapsulated iron nanoparticles double their sorption performance in the removal of $AuCl_4^-$ from aqueous solution
- I have demonstrated the potent applications of carbon-encapsulated iron nanoparticles in various electrochemical processes

5. Summary of other scientific achievements

I have published more papers on carbon-encapsulated magnetic nanoparticles, which have not been included in the Summary of scientific achievements in relation to habilitation procedure. In 2008 I started collaboration with a research group from Estonia, which specializes in applications of carbon materials for energy storage. We have examined the basic electrochemical characteristics of carbon-encapsulated magnetic nanoparticles in highly alkaline conditions (6M KOH), using direct and alternative polarization regimes[14]. We have shown, that the carbon coating perfectly protects the encapsulated nanoparticles (the coating was tight in 3 of 4 studied samples). We have derived the specific capacitance (10-40 F/g), which correlated both with textural properties and the content of CEMNPs in studied samples. We have shown that despite relatively high density (in refer to materials made of pure carbon), carbon-encapsulated magnetic nanoparticles have higher specific capacitance in comparison to carbon black and multi-wall carbon nanotubes. Moreover, the electrodes derived from CEMNPs have low contact resistivity. The result obtained in work [H15] clearly show that carbon-encapsulated magnetic nanoparticles may be promising materials for the construction of electrodes and various electrochemical applications.

In collaboration with dr Magdalena Popławska from Department of Chemistry at Warsaw University of Technology we have developed a method for covalent functionalization of carbon-encapsulated magnetic nanoparticles[15]. The method is based on the cycloaddition of nitile oxide derivatives and results high functionalization yields (the surface ligands content is up to 20% of the total mass of functionalized CEMNP). This functionalization approach is also suitable for functionalization of other carbon nanomaterials, e.g. fullerenes and multi-wall carbon nanotubes.

In 2009-2012 I was realized a research project with Medical University of Warsaw (group of prof. I. Grudziński) and Dept of Chemistry, Warsaw University of Technology (dr M. Popławska). The project was aimed on molecular imaging of cancer tumors by magnetic resonance. The objective of the project was to develop the selective contrast agent, which is able for the targeting recognition of cancer cells under *in vivo* conditions. The contrast agent was based on carbon-encapsulated iron nanoparticles, which were synthesized by me. The CEMNPs were pre-functionalized in order to introduce the appropriate surface scaffolding for further immobilization of monoclonal antibody, which recognizes the integrin receptors. The integrin receptors are typical for a few lines of common cancer less (malignant melanoma, glioma, Lewis lung carcinoma). We have found that the immobilization efficiency of various biomolecules (gamma globulines, polyclonal antibodies) is strictly related to the length of the linking ligand introduced onto the surface of CEMNPs. The longer linkers

[14] **M. Bystrzejewski**, M. Arulepp, J. Leis, A. Huczko, H. Lange. *Electrochemical characterization of core-shell carbon-encapsulated magnetic nanoparticles*. Materials Letters, 2009, 63, 1435-1438.
[15] M. Popławska, Z. Żukowska, S. Cudziło, **M. Bystrzejewski**. *Functionalization of carbon-encapsulated magnetic nanoparticles by cycloaddition of nitrile oxides*. Carbon 2010, 48, 1318-1320.

have better performance and result in higher immobilization yield[16]. The project also included systematic studies on determination of cytotoxicity under *in vitro* conditions. It has been shown that the cytotoxic response is strictly correlated with surface chemistry and corresponding surface charge[17]. It has been also demonstrated that the cytotoxic potential of CEMNPs is higher for malignant melanoma cells in comparison to "healthy" cells (fibroblasts). In another paper the cytotoxicity patterns of CEMNPs were evaluated on Lewis lung carcinoma cells[18]. I have built a model of cellular internalization, which take into account the changes of zeta potential[18,19]. The model nicely predicted the internalization pathways of CEMNPs in Lewis cancer cells. I have also showed that a careful analysis of TEM images, diameter distribution of CEMNPs and simple geometrical consideration allows to predict the Fe content in incubated cells. The predicted Fe content perfectly correlated with the results obtained from ICP MS analysis. We are currently preparing new manuscripts, which will deal with analysis of relaxation properties of CEMNPs in magnetic resonance imaging, imaging of tumors *in vivo*, and pharmacokinetics and metabolomics of carbon-encapsulated iron nanoparticles after injection within a vein.

Beside the scientific activity shown above in the field of carbon-encapsulated magnetic nanoparticles I collaborate with domestic research groups. In this collaboration I use my experience in physics and chemistry of carbon materials.

Since 2008 I informally collaborate with the group of Prof. Andrzej Świątkowski from the Dept of Chemistry and New Technologies at Military University of Warsaw. Our activity is focused on two fields: (i) combustion synthesis of carbon materials, (ii) studies on activated carbons. In the first case we have explored the combustion synthesis in the reactant system: sodium azide – perchlorocarbons. We have obtained carbon nanoparticles, which have similar structure and morphology to carbon blacks[20]. We have also performed detailed studies on high temperature treatment of granular activated carbon. We have found that thermal treatment substantially

[16] M. Poplawska, **M. Bystrzejewski**, I.P. Grudzinski, M.A. Cywinska, J. Ostapko, A.Cieszanowski, *Immobilization of gamma globulins and polyclonal antibodies of class IgG onto carbon-encapsulated iron nanoparticles functionalized with various surface linkers*. Carbon 2014, in press.

[17] I.P. Grudziński, **M. Bystrzejewski**, M.A. Cywińska, A. Kosmider, M. Popławska, A. Cieszanowski, A. Ostrowska, *Cytotoxicity Evaluation of Carbon-Encapsulated Iron Nanoparticles in Melanoma Cells and Dermal Fibroblasts*. Journal of Nanoparticle Research 2013, 15, 1835 (1-18).

[18] I. Grudzinski , **M. Bystrzejewski**, M. Cywinska, A. Kosmider, M. Poplawska, A. Cieszanowski, Z. Fijalek, A. Ostrowska, A. Parzonko, *Assessing carbon-encapsulated iron nanoparticles cytotoxicity in Lewis lung carcinoma*, Journal of Applied Toxicology 2014, 34, 380-394.

[19] I.P. Grudzinski, **M. Bystrzejewski**, M.A. Cywinska, A. Kosmider, M. Poplawska, A.Cieszanowski, Z. Fijalek, A. Ostrowska, *Comparative cytotoxicity studies of carbon-encapsulated iron nanoparticles tested at different stages of synthesis in murine glioma cells*, Colloids and Surfaces B 2014, 117, 135-143.

[20] S. Cudziło, A. Huczko, M. Pakuła, S. Biniak, A. Świątkowski, M. Szala, **M. Bystrzejewski**. *Physicochemical Properties of Carbon Materials Obtained via Combustion Synthesis of Perchlorinated Hydrocarbons.* Carbon Science and Technology, 2010, 3, 131-138.

increases the graphitization degree and irreversibly destroys the inherent porous structure[21]. Our recent works were devoted to the processing of waste PET. We have obtained a highly microporous activated carbon with the specific surface area higher than 1200 m^2/g [22]. Our current activity is focused on combustion synthesis in the reactant system magnesium – oxalates/carbonates of alkaline metals. The reaction is accompanied by a relatively high reaction heat and leads to carbon materials of high graphitization degree and relatively large volume of mesopores.

I also collaborate with dr W. Kiciński from Military University of Warsaw. Our research is devoted to microporous carbons with high graphitization degree. The idea is based on the synthesis of carbon xero- or aero- gel doped with salts of transition metals. The inherent porosity is developed during the carbonization process, because of the evolved gases resulting from the decomposition of both the carbon gel and the metal salt. We have published two joint papers on this topic[23,24]. Very recently, we have prepared a comprehensive review on porous carbon doped with sulfur. This manuscript has been published in Carbon[25].

In 2012 I have started the collaboration with prof. Andrzej Czerwiński from the Laboratory of Electrochemical Energy Sources (Dept of Chemistry, Univeristy of Warsaw) and I began the realization of the project financed by the National Centre for Research and Development. The project concerns the lead-acid battery of high energy density, which is based on the reticulated vitreous carbon. The use of reticulated carbon results in a large reduction of the mass of the battery and leads to a substantial increase of its specific energy. My role in this project is to develop a technology to fabricate the reticulated vitreous carbon from the domestic sources of starting materials and chemicals. Up to date, I have optimized the carbonization process of the precursor, which is characterized by a low energy consumption. I have also specified the conditions, at which the carbonization process can be carried out without the blow of neutral gas. Currently, we are preparing a patent application on that.

[21] S. Biniak, M. Pakuła, A. Świątkowski, **M. Bystrzejewski**, S. Błażewicz. *Influence of high-temperature treatment of granular activated carbon on its structure and electrochemical behavior in aqueous electrolyte solution*. Journal of Materials Research 2010, 25, 1617-1626.

[22] W. Bratek, A. Świątkowski, M. Pakuła, S. Biniak, **M. Bystrzejewski**, R. Szmigielski. *Characteristics of activated carbon prepared from waste PET by carbon dioxide activation.* Journal of Analytical and Applied Pyrolysis 2013, 100, 192-198.

[23] W. Kiciński, M. Norek, **M. Bystrzejewski**, *Monolithic porous graphitic carbons obtained through catalytic graphitization of carbon xerogels*, Journal of Physics and Chemistry of Solids 2013, 74, 101-109.

[24] W. Kiciński, M. Norek, M.H. Ruemmeli, T. Gemming, **M. Bystrzejewski**, *Synthesis of porous graphitic materials obtained from carbonization of xerogels doped with transition metal salts*, Bulletin of Materials Science, 2014, in press

[25] W. Kiciński, M. Szala, **M. Bystrzejewski**, *Sulfur-doped Porous Carbons: Synthesis and Applications*, Carbon 2014, 68, 1-32

I also actively collaborate from my home laboratory led by prof. A. Huczko. I engaged in structural studies of silicon carbide[26,27,28]. Since 2013 we realize the project (financed by the National Research Centre), which is a new approach to synthesis highly exfoliated graphite. This type of graphite is a chemically pure precursor of high quality graphene. Our original approach eliminates any reaction with the use of oxidizing agents and is an alternative to the commonly used Hummers method

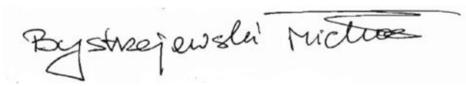
I am also trying to explore new branches of research, which may be in near future the new directions of scientific activity. I benefit from the help of my BSc and MSc studies, which perform this preliminary and exploratory studies and examinations. This currently developing activities indlude:

(i) controlled surface modification of carbon materials via glow discharges generated at various current polarization regimes (from d.c., through acoustic up to megahertz range)

(ii) stable water suspensions of carbon-encapsulated magnetic nanoparticles stabilized by polymers of low cytotoxic potential

(iii) humic acids of natural and synthetic origin – synthesis and structural studies with an indication of direct similarities to graphite oxide and graphene oxide

(iv) Macroporous conductive magnetic carbon composites – synthesis and applications in electrochemistry, energy storage and sorption of petroleum materials



[26] A. Huczko, **M. Bystrzejewski**, H. Lange, A. Fabianowska, S. Cudziło, A. Panas, M. Szala. *Combustion synthesis as a novel method for production of 1-D SiC nanostructures*. Journal of Physical Chemistry B 2005, 109, 16244-16251.
[27] M. Soszyński, A. Dąbrowska, **M. Bystrzejewski**, A. Huczko, *Combustion Synthesis of One-Dimensional Nanocrystalline Silicon Carbide*. Crystal Research and Technology 2010, 45, 1241-1244.
[28] A. Huczko, A. Dąbrowska, M. Soszyński, N. Maryan, **M. Bystrzejewski**, H. Lange, P. Baranowski, T. Gemming, A. Bachmatiuk, M. Rümmeli. *Ultra-fast self-catalytic growth of silicon carbide nanowires.* Journal of Materials Research 2011, 26, 3065-3071.

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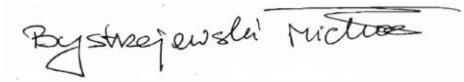
List of published scientific papers or professional creative works and information on teaching achievements, scientific collaborations and popularization of science

Warsaw, May 2014

I. Identification of achievement pursuant to Art.16(2) of the Act of 14 March 2003 on scientific degrees and artistic titles (Journal of Laws no. 65, item 595 as amended) setting the basis for the habilitation proceedings

A) Title of scientific achievement: **Synthesis, properties and applications of selected hybrid magnetic carbon nanomaterials**



B) List of scientific publications setting the basis for habilitation proceedings:

[H1] **M. Bystrzejewski**, O. Łabędź, W. Kaszuwara, A. Huczko, H. Lange, *Controlling the diameter and magnetic properties of carbon-encapsulated iron nanoparticles produced by carbon arc discharge*. Powder Technology 2013, 246, 7-15. **IF(2012)=2.024**

Author's contribution = 70%, corresponding author; citations:1

I have stated the scientific problem, planned the experimental works, written the whole manuscript, analyzed the results and performed the revised version of the manuscript.

[H2] **M. Bystrzejewski**, O. Łabędź, H. Lange, *Diagnostics of carbon arc plasma under formation of carbon-encapsulated iron nanoparticles by emission and absorption spectroscopy*. Journal of Physics D: Applied Physics 2013, 46, 355501 (1-10). **IF(2012)=2.528**

Author's contribution = 75%, corresponding author; citations:0

I have stated the scientific problem, planned the experimental, written the whole manuscript, analyzed the results and performed the revised version of the manuscript.

[H3] **M. Bystrzejewski**, Z. Karoly, J. Szepvolgyi, W. Kaszuwara, A. Huczko, H. Lange. *Continuous synthesis of carbon encapsulated magnetic nanoparticles with a minimum production of amorphous carbon.* Carbon 2009, 47, 2040-2048. **IF(2009)=4.504**

Author's contribution = 65%, corresponding author; citations:19

I have stated the scientific problem, planned the experimental works, written the whole manuscript, analyzed the results and performed the revised version of the manuscript.

[H4] **M. Bystrzejewski**, Z. Karoly, J. Szepvolgyi, A. Huczko, H. Lange. *Continuous synthesis of controlled size carbon-encapsulated iron nanoparticles*. Materials Research Bulletin, 2011, 46, 2408-2417. **IF(2011)=2.105**

Author's contribution = 70%, corresponding author; citations:2

I have stated the scientific problem, planned the experimental works, written the manuscript (95%), analyzed the results (90%) and performed the revised version of the manuscript.

[H5] **M. Bystrzejewski**, M. Szala, W. Kiciński, W. Kaszuwara, M.H. Rummeli, T. Gemming, A Huczko. *Self-sustaining high-temperature synthesis of carbon-encapsulated nanoparticles from organic and inorganic metal precursors.* New Carbon Materials 2010, 25, 81-88. **IF(2010)=0.888**

Author's contribution = 45%, corresponding author; citations:0

I have partially stated the scientific problem, planned and performed the experimental works (60%), written the manuscript (80%), analyzed the results (60%) and performed the revised version of the manuscript.

[H6] **M. Bystrzejewski**, H. Lange, A. Huczko, P. Baranowski , H.W. Hubers, T. Gemming, T. Picher, B. Buchner, M. H. Rümmeli. *One-step catalyst-free generation of carbon nanospheres via laser-induced pyrolysis of anthracene*. Journal of Solid State Chemistry 2008, 181, 2796-2803. **IF(2008)=1.910**

Author's contribution = 55%, corresponding author; citations:17

I have stated the scientific problem, planned and performed the experimental works (80%), written the manuscript (80%), analyzed the results and performed the revised version of the manuscript.

[H7] **M. Bystrzejewski**, H.W. Hubers, A. Huczko, T. Gemming, B. Buchner, M.H. Rummeli. *Bulk synthesis of carbon nanocapsules and nanotubes containing magnetic nanoparticles via low energy laser pyrolysis of ferrocene*. Materials Letters 2009, 63, 1767-1770. **IF(2009)=1.940**

Author's contribution = 70%, corresponding author; citations:2

I have stated the scientific problem, planned and performed the experimental works, written the whole manuscript, analyzed the results and performed the revised version of the manuscript.

[H8] **M. Bystrzejewski**, R. Klingeler, T. Gemming, B. Bucher, M.H. Rummeli. *Low temperature synthesis of carbon-encapsulated iron nanoparticles: a critical evaluation of yield and selectivity.* Nanotechnology 2011, 22, 315606. **IF(2011)=3.979**

Author's contribution = 70%, corresponding author; citations:4

I have stated the scientific problem, planned and performed the experimental works, written the manuscript (90%), analyzed the results and performed the revised version of the manuscript.

[H9] **M. Bystrzejewski**. *Synthesis of carbon-encapsulated iron nanoparticles via solid state reduction of iron oxide nanoparticles*. Journal of Solid State Chemistry 2011, 184, 1492-1498. **IF(2011)=2.159**

Author's contribution = 100%, corresponding author; ; citations:4

I have stated the scientific problem, planned and performed the experimental works, written the whole manuscript, analyzed the results and performed the revised version of the manuscript.

[H10] **M. Bystrzejewski**, A. Grabias, J. Borysiuk, A. Huczko, H. Lange. *Mőssbauer spectroscopy of carbon-encapsulated magnetic nanoparticles obtained by different routes*. Journal of Applied Physics 2008, 104, 54307. **IF(2008)=2.201**

Author's contribution = 40%, corresponding author; citations:6

I have stated the scientific problem, planned and performed the experimental works (40%), written the manuscript (50%), analyzed the results (60%) and performed the revised version of the manuscript.

[H11] **M. Bystrzejewski**, A. Grabias. *Tailoring phase composition in carbon-encapsulated iron nanoparticles*. Materials Characterization, 2011, 62, 152-156. **IF(2011)=1.572**

Author's contribution = 60%, corresponding author; citations:2

I have stated the scientific problem, planned and performed the experimental works (50%), written the manuscript (70%), analyzed the results (50%) and performed the revised version of the manuscript.

[H12] **M. Bystrzejewski**, K. Pyrzyńska, A. Huczko, H. Lange. *Carbon-encapsulated magnetic nanoparticles as separable and mobile sorbents of heavy metal ions from aqueous solutions*. Carbon 2009, 47, 1201-1204. **IF(2009)=4.504**

Author's contribution = 50%, corresponding author; citations:36

I have stated the scientific problem, planned and performed the experimental works (50%), written the manuscript (50%), analyzed the results (70%) and performed the revised version of the manuscript.

[H13] K. Pyrzyńska, **M. Bystrzejewski**. *Comparative studies of heavy metal ions adsorption onto activated carbon, carbon nanotubes and carbon-encapsulated magnetic nanoparticles.* Colloids&Surfaces A 2010, 362, 102-109. **IF(2010)=2.130**

Author's contribution = 50%, corresponding author; citations:47

I have stated the scientific problem, planned and performed the experimental works (40%), written the manuscript (70%), analyzed the results (65%) and performed the revised version of the manuscript.

[H14] **M. Bystrzejewski**, K. Pyrzyńska. *Kinetics of copper ions sorption onto activated carbon, carbon nanotubes and carbon-encapsulated magnetic nanoparticles*. Colloids & Surfaces A 2011, 377, 402-408. **IF(2011)=2.236**

Author's contribution = 60%, corresponding author; citations:11

I have stated the scientific problem, planned and performed the experimental works (40%), written the manuscript (80%), analyzed the results (90%) and performed the revised version of the manuscript.

[H15] **M. Bystrzejewski**, K. Pyrzyńska. *Enhancing the efficiency of Au adsorption onto activated carbon and carbon nanomaterials*. Material Chemistry and Physics 2013, 141, 454-460. **IF(2012)=2.072**

Author's contribution = 70%, corresponding author; citations:0

I have stated the scientific problem, planned and performed the experimental works (40%), written the manuscript (90%), analyzed the results (70%) and performed the revised version of the manuscript.

[H16] A.M. Nowicka, A. Kowalczyk, **M. Bystrzejewski**, M. Donten, Z. *Stojek Carbon-encapsulated iron nanoparticles used to generate magnetic field and to enhance substrate transport at electrode surface*. Electrochemistry Communications 2012, 20, 4-6. **IF(2012)=4.425**

Author's contribution = 20%; citations:1

I have synthesized and purified carbon encapsulates, measured the distribution of magnetic field strength, written a part of the manuscript (20%) and analyzed the results (20%).

[H17] **M. Bystrzejewski**. Magnetic composites of carbon materials: synthesis, structure and applications. Przemysł Chemiczny 2011, 90, 399-405. **IF(2011)=0.414**

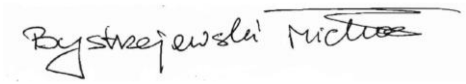
Author's contribution = 100%; citations:1

I have stated the scientific problem, searched the cited references and written the whole manuscript. I estimate my contribution to be 100%.

[H18] A. Huczko, **M. Bystrzejewski**, H, Lange, P. Baranowski, "Formation and Characterization of Carbon and Ceramic Nanostructures" in: Physical Properties of Ceramic and Carbon Nanoscale Structures. Ed. S. Bellucci, Springer-Verlag, Berlin Heidelberg 2011 (1-44).

I have written the hole section on carbon-encapsulated magnetic nanoparticles. I estimate my contribution to be 33%.

Total impact factor of papers listed above according to the list from Journal Citation Reports: 41.561



II. List of other scientific publications (not included in point IB) and research and scientific achievement indices

A) Publications indexed in JCR database

Paper published before PhD thesis defence:

1. **M. Bystrzejewski**, A. Huczko, H. Lange, P. Baranowski, J. Kozubowski, M. Woźniak, M. Leonowicz, W. Kaszuwara, Arc Plasma Synthesis of (Fe-Nd-B)-Containing Carbon Encapsulates. Solid State Phenomena 2004, 99-100, 273-278. IF(2004)=0.461

I contributed in synthesis and characterization of prodcuts and writing a part of the manuscript. I estimate my contribution to be 50%.

2. **M. Bystrzejewski**, A. Huczko. Heterogeneous carbon nanoclusters - preparation, characteristics, and prospective applications. Przemysł Chemiczny 2005, 84, 92-96. IF(2005)=0.104

I contributed in partial development in the manuscript preparation (80%) and seeking the cited articles. I estimate my contribution to be 75%.

3. A. Huczko, H. Lange, **M. Bystrzejewski**, S. Cudziło. Studies on spontaneous formation of 1D nanocrystals of silicon carbide. Crystal Research and Technology 2005, 40, 334-339. IF=0.833

I contributed in SEM analysis of products. I estimate my contribution to be 8%.

4. A. Huczko, H. Lange, **M. Bystrzejewski**, P. Baranowski, H. Grubek-Jaworska, P. Nejman, T. Przybyłowski, K. Czumińska, J. Glapiński, D.R.M. Walton, H.W. Kroto. Pulmonary toxicity of 1D nanocarbon materials. Fullerenes, Nanotubes and Carbon Nanostructures 2005, 13, 141-145. IF(2005)=0.776

I contributed in SEM analysis of products. I estimate my contribution to be 8%.

5. S. Cudziło, **M. Bystrzejewski**, H. Lange, A. Huczko. Spontaneous Formation of Carbon-based Nanostructures by Thermolysis-induced Carbonization of Halocarbons. Carbon 2005, 43, 1778-1782. IF=3.419

I contributed in SEM analysis of products. I estimate my contribution to be 8%.

6. **M. Bystrzejewski**, H. Lange, A. Huczko. Arc Plasma Synthesis of Carbon Encapsulates Containing Fe-Nd-B. Journal of High Temperature Material Processes 2005, 9, 237-243. IF(2005)=0.262

I have partially stated the scientific problem (60%), synthesized and characterized the products, written the part of the manuscript. I estimate my contribution to be 70%.

7. J. Yi Zheng, G. Chao, H. Wen Kuang, A. Huczko, **M. Bystrzejewski**, M. Roe, C.Y. Lee, S. Acquah, H.W. Kroto, D.R.M. Walton. A systematic study of the large-scale synhesis and characterization of carbon spheres prepared by direct pyrolysis of hydrocarbons. Carbon 2005, 43, 1944-1953. IF(2005)=3.419

I contributed in synthesis of carbon spheres and their characterization by electron microscopy. I estimate my contribution to be 8%.

8. **M. Bystrzejewski**, A. Huczko, H. Lange. Arc plasma route to magnetic carbon-encapsulated nanoparticles for biomedical applications. Sensors&Actuators B 2005, 109, 81-85. IF(2005)=2.646

I have partially stated the scientific problem, synthesized and characterized the products, written the part of the manuscript. I estimate my contribution to be 80%.

9. **M. Bystrzejewski**, H. Lange, A. Huczko, Z. Karoly, L. Gal. RF plasma synthesis of carbon encapsulates. Polish Journal of Applied Chemistry 2005, 49, 23-31. IF(2005)=0

I contributed in synthesis and characterization of products and preparation of the manuscript (75%). I estimate my contribution to be 40%.

10. A. Huczko, **M. Bystrzejewski**, H. Lange, A. Fabianowska, S. Cudziło, A. Panas, M. Szala. Combustion synthesis as a novel method for production of 1-D SiC nanostructures. Journal of Physical Chemistry B 2005, 109, 16244-16251. IF(2005)=4.033

I contributed in performing electron microscopy and Raman spectroscopy analyses. I estimate my contribution to be 15%.

11. H. Grubek-Jaworska, P. Nejman, K. Czumińska, T. Przybyłowski, A. Huczko, H. Lange, **M. Bystrzejewski**, P. Baranowski, R. Chazan. Preliminary results on the pathogenic effects of

intratracheal exposure to one-dimensional nanocarbons. Carbon 2006, 44, 1057-1063. IF(2006)=3.884

I contributed in performing electron microscopy and estimated the Fe content in the studied samples. I estimate my contribution to be 10%.

12. A. Huczko, H. Lange, **M. Bystrzejewski**, P. Baranowski, Y. Ando, X. Zhao, S. Inoue. Formation of SWCNTs in Arc Plasma: Effect of Graphitization of Fe-doped Anode and Optical Emission Studies. Journal of Nanoscience and Nanotechnology 2006, 6, 1319-1324. IF(2006)=2.194

I have synthesized and characterized the products and written a part of the manuscript (15%). I estimate my contribution to be 15%.

13. H. Lange, **M. Bystrzejewski**, A. Huczko. Influence of carbon nanostructure on carbon nanotube and carbon arc plasma. Diamond and Related Materials 2006, 15, 1113-1116. IF(2006)=1.935

I contributed in synthesis and characterization of products and writing the manuscript (35%). I estimate my contribution to be 40%.

14. **M. Bystrzejewski**, H. Lange, A. Huczko, M. Ruemelli, T. Gemming, T. Pichler. Synthesis of heteregenous multi-walled carbon nanotubes in a carbon arc in water. Fullerenes, Nanotubes and Carbon Nanostructures 2006, 14, 207-213. IF(2006)=0.462

I have partially stated the scientific problem, written a part of the manuscript (70%), and analyzed the samples by electron microscopy. I estimate my contribution to be 60%.

15. **M. Bystrzejewski**, S. Cudziło, A. Huczko, H. Lange. Thermal stability of carbon-encapsulated Fe-Nd-B nanoparticles. Journal of Alloys and Compounds 2006, 423, 74-76. IF(2006)=1.250

I have stated the scientific problem, written a part of the manuscript (85%) and analysed the results (75%). I estimate my contribution to be 60%.

16. M. Wozniak, P. Wozniak, **M. Bystrzejewski**, S. Cudzilo, A. Huczko, P. Jelen, W. Kaszuwara, J.A. Kozubowski, H. Lange, M. Leonowicz, M. Lewandowska-Szumiel. Magnetic nanoparticles of Fe and Nd-Fe-B alloy encapsulated in carbon shells for drug delivery systems: study of the structure and interaction with the living cells. Journal of Alloys and Compounds 2006, 423, 87-91. IF(2006)=1.250

I have synthesized and purified the samples for in vitro studies. I estimate my contribution to be 10%.

17. E. Kowalska, P. Kowalczyk, J. Radomska, E. Czerwosz, **M. Bystrzejewski**. The influence of high vacuum annealing on some properties of carbon nanotubes. Journal of Thermal Analysis and Calorimetry 2006, 86, 115-119. IF(2006)=1.438

I contributed in the discussion on thermal analysis of carbon nanotubes. I estimate my contribution to be 5%.

18. A. Huczko, H. Lange, **M. Bystrzejewski**, A. Fabianowska, S. Cudziło, M. Szala, A.T.S. Wee, K.C. Chin. One–dimensional ceramic nanostructures spontaneously formed by combustion synthesis. Physica Status Solidi B 2006, 243, 3297-3300. IF(2006)=0.967

I contributed in performing analysis by electron microscopy and Raman spectroscopy. I estimate my contribution to be 15%.

19. **M. Bystrzejewski**, A. Huczko, H. Lange, S. Cudziło, W. Kiciński. Combustion synthesis route to carbon-encapsulated iron nanoparticles. Diamond and Related Materials 2007, 16, 225-228. IF(2007)=1.788

I have stated the scientific problem, written a part of the manuscript (60%), and analyzed the results (75%). I estimate my contribution to be 50%.

20. **M. Bystrzejewski**, A. Huczko, H. Lange, P. Baranowski, Gervais Soucy, German Cota-Sanchez, J. Szczytko, A, Twardowski. Large Scale Synthesis of Carbon Encapsulated Magnetic Nanoparticles. Nanotechnology 2007, 18, 145608. IF(2007)=3.310

I have stated the scientific problem, synthesized and purified the samples (40%), analyzed the resuls (75%), written a part of the manuscript (60%). I estimate my contribution to be 50%.

21. **M. Bystrzejewski**, H. Lange, A. Huczko. Carbon Encapsulation of Magnetic Nanomaterials. Fullerenes, Nanotubes and Carbon Nanostructures 2007, 15, 167-180. IF(2007)=0.497

I have stated the scientific problem, synthesized, purified and characterized of the products, analysed the results (75%), written a part of the manuscript (60%). I estimate my contribution to be 75%.

22. S. Cudziło, M. Szala, A. Huczko, M**. Bystrzejewski**. Combustion Reactions of Poly(Carbon Monofluoride), (CF)n, with Different Reductants and Characterization of the Products. Propellants, Explosives, Pyrotechnics 2007, 32, 149-154. IF(2007)=1.222

I contributed in the discussion on electron microscopy images of the products. I estimate my contribution to be 5%.

23. **M. Bystrzejewski**, M.H. Rummeli. Novel Nanomaterials for Prospective Biomedical Applications: Synthesis, Structure and Toxicity. Polish Journal of Chemistry 2007, 81, 1219-1255. IF(2007)=0.483
I have stated the scientific problem, searched the cited articles and written a part of t he manuscript (90%). I estimate my contribution to be 85%.

24. M.H. Rummeli, C. Kramberger, M. Loffler, O. Jost, A. Gruneis, **M. Bystrzejewski**, T. Gemming, W. Pompe, B. Buchner, T. Pichler. Catalyst volume to surface area constraints for nucleating single wall carbon nanotubes in laser evaporation synthesis. Journal of Physical Chemistry B 2007, 111, 8234-8241. IF(2007)=4.086
I contributed in discussion on the analysis of electron microscopy images. I estimate my contribution to be 5%.

25. **M. Bystrzejewski**, H. Lange, A. Huczko, H.I. Elim, W. Ji. Study of the optical limiting properties of carbon-encapsulated magnetic nanoparticles. Chemical Physics Letters 2007, 444, 113-117. IF(2007)=2.207
I have stated the scientific problem, synthesized t he materials for optical limiting studies, analuzed the results (50%). I estimate my contribution to be 40%.

26. A. Huczko, M .Osica, A. Rutkowska, **M. Bystrzejewski**, H. Lange, S. Cudziło. A self–assembly SHS approach to form silicon carbide nanofibres. Journal of Physics Condensed Matter 2007, 19, 395022. IF(2007)=1.886
I contributed in the analysis of phase composition by X-ray diffraction. I estimate my contribution to be 10%.

27. A. Huczko, M. Osica, **M. Bystrzejewski**, H. Lange, S. Cudziło, J. Leis, M. Arulepp. Characterization of 1-D NanoSiC-Derived Nanoporous Carbon.Physica Status Solidi B 2007, 244, 3969-3972. IF(2007)=1.071
I contributed in the analysis of phase composition by X-ray diffraction. I estimate my contribution to be 10%.

28. **M. Bystrzejewski**, A. Huczko, H. Lange, J. Drabik. E. Pawelec. Oxidation Resistance of Fullerene-Containing Vegetable Oils. Fullerenes, Nanotubes and Carbon Nanostructures 2007, 15, 427-438. IF(2007)=0.497

I have partially stated the scientific problem (30%), analyzed the thermal analysis curves and written a part of the manuscript (90%). I estimate my contribution to be 50%.

29. J. Szczytko, P. Osewski, **M. Bystrzejewski**, J. Borysiuk, A. Grabias, A. Huczko, H. Lange, A. Majhofer, A. Twardowski. Carbon-encapsulated magnetic nanoparticles based on Fe, Mn and Cr for spintronics applications. Acta Physica Polonica A 2007, 112, 305-310. IF(2007)=0.340
I contributed in synthesis and purification of products. I estimate my contribution to be 10%.

30. **M. Bystrzejewski**, S. Cudziło, A. Huczko, H. Lange, G. Soucy, G. Cota-Sanchez, W. Kaszuwara. Carbon encapsulated magnetic nanoparticles for biomedical applications: thermal stability studies. Biomolecular Engineering 2007, 24, 555-558. IF(2007)=4.246
I have state the scientific problem, synthesized, purified and characterized the products, analyzed the results (75%) and written a part of the manuscript (80%). I estimate my contribution to be 60%.

31. **M. Bystrzejewski**, A. Huczko, H. Lange, W.W. Płotczyk, R. Stankiewicz, M.H. Rummeli, T. Pichler, T. Gemming. Synthesis of carbon nanotubes by DC thermal plasma jet. Applied Physics A 2008, 91, 223-228. IF(2008)=1.884
I contributed in synthesis and purification of products, analysis of results (40%), preparation of the manuscript (50%). I estimate my contribution to be 30%.

32. J. Borysiuk, A. Grabias, J. Szczytko, **M. Bystrzejewski**, A. Twardowski, H. Lange. *Structure and magnetic properties of carbon encapsulated Fe nanoparticles obtained by arc plasma and combustion synthesis.* Carbon 2008, 46, 1693-1701. **IF(2008)=4.373**
I contributed in synthesis of carbon-encapsulated iron nanoparticles, performing experimental part (20%), writting the manuscript (20%) – sections 3.3 and 4, and interpretation of results (10%).

33. **M. Bystrzejewski**, A. Huczko, H. Lange. *Sedimentation of nanocarbon materials in organic solvents.* Materials Chemistry and Physics 2008, 107, 322-327. **IF=1.799**
Author's contribution = 85%; citations:2
I have stated the scientific problem, planned and performed the experimental works, written the whole manuscript, analyzed the results (90%) and performed the revised version of the manuscript.

Paper published after PhD thesis defence:

34. **M. Bystrzejewski**, R. Schonfelder, G, Cuniberti, H. Lange, A. Huczko, T. Gemming, T. Pichler, B. Buchner, M.H. Rummeli. Exposing multiple roles of H2O in high temperature enhanced carbon nanotubes synthesis. Chemistry of Materials 2008, 20, 6566-6568. IF(2008)=5.046

I contributed in synthesis and characterization of products and preparation of the manuscript (60%).I estimate my contribution to be 30%.

35. **M. Bystrzejewski**, M. H. Rűmmeli, H. Lange, A. Huczko, P. Baranowski, T. Gemming, T. Pichler. Single-walled carbon nanotubes synthesis: a direct comparison of laser ablation and carbon arc routes. Journal of Nanoscience and Nanotechnology 2008, 8, 6178-6186. IF(2008)=1.929

I have stated the scientific problem, synthesized, purified and characterized the products, analyzed the results (70%) and written a part of the manuscript (60%). I estimate my contribution to be 50%.

36. **M. Bystrzejewski**, M.H. Rummeli, T. Gemming, T. Pichler, A. Huczko, H. Lange, Functionalizing single-wall carbon nanotubes in hollow cathode glow discharges. Plasma Chemistry and Plasma Processing 2009, 29, 79-90. IF(2009)=2.039

I have stated the scientific problem, synthesized and characterized the products, analysed the results (90%) and written a part of the manuscript (85%). I estimate my contribution to be 60%.

37. **M. Bystrzejewski**, M.H. Rümmeli, T. Gemming, H. Lange, A. Huczko. *Catalyst-free synthesis of onion-like carbon nanoparticles.* New Carbon Materials 2010, 25, 1-8. **IF(2010)=0.888**

I have stated the scientific problem, performed the experimental part (80%), written the manuscript (95%) and analyzed all results. I estimate my contribution to be 80%.

38. **M. Bystrzejewski**, A. Huczko, M. Soszyński, S. Cudziło, W. Kaszuwara, M.H. Rummeli, T. Gemming, H. Lange. *An easy one-step route to carbon-encapsulated magnetic nanoparticles*. Fullerenes, Nanotubes and Carbon Nanostructures 2009, 17, 600-615. **IF(2009)=0.710**

I have stated the scientific problem, performed the experimental part (80%), written the manuscript (95%) and analyzed all results. I estimate my contribution to be 55%.

39. **M. Bystrzejewski**, M. Arulepp, J. Leis, A. Huczko, H. Lange. *Electrochemical characterization of core-shell carbon-encapsulated magnetic nanoparticles*. Materials Letters, 2009, 63, 1435-1438. **IF(2009)=1.940**

I have stated the scientific problem, performed the experimental part (60%), written the manuscript (70%) and analyzed a part of results (60%). I estimate my contribution to be 60%.

40. **M. Bystrzejewski**, A. Huczko, P. Byszewski, M. Domańska, M.H. Rümmeli, T. Gemming, H. Lange. Systematic Studies on Carbon Nanotubes Synthesis from Aliphatic Alcohols by CVD Floating Catalyst Method. Fullerenes, Nanotubes and Carbon Nanostructures 2009, 17, 298-307. IF(2009)=0.710
I have partially stated the scientific problem (40%), synthesized and characterized the products (30%), analyzed the results (70%) and written a part of the manuscript (70%). I estimate my contribution to be 40%.

41. O. Łabędź, H. Lange, A. Huczko, J. Borysiuk, M. Szybowicz, **M. Bystrzejewski**. Influence of carbon structure of the anode on the synthesis of single-walled carbon nanotubes in a carbon arc plasma. Carbon 2009, 47, 2847-2854. IF(2009)=4.504
I have partially prepared the manuscript (20%) and discussed the results. I estimate my contribution to be 15%.

42. **M. Bystrzejewski**, A. Bachmatiuk, J. Thomas, P. Ayala, J. Serwatowski, H.W. Hubers, T. Gemming, E. Borowiak-Palen, T. Pichler, R.J. Kalenczuk, B. Buchner, M.H. Rümmeli. Boron Doped Carbon Nanotubes via Ceramic Nanowires. Physica Status Solidi - Rapid Research Letters 2009, 3, 193-195. IF(2009)=2.560
I have partially stated the scientific problem (70%), performed the experiments and characterized the products (40%). I estimate my contribution to be 30%.

43. A. Bachmatiuk, **M. Bystrzejewski**, F. Schaffel, P. Ayala, U. Wolf, C. Mickel, T. Gemming, T. Pichler, E. Borowiak-Palen, R. Klingeler, H.W. Hubers, M. Ulbrich, D. Haberer, B. Buchner, M.H. Rummeli. Carbon nanotube synthesis via ceramic catalysts. Physica Status Solidi B 2009, 11-12, 2486-2489. IF(2010)=1.150
I have synthesized a part of studied materials. I estimate my contribution to be 5%.

44. **M. Bystrzejewski**, A. Huczko, P. Kowalczyk, M. Rogala, M. Szybowicz, M.H. Rummeli, T. Gemming, H. Lange. Ultra highly selective synthesis of double-wall carbon nanotubes. Fullerenes, Nanotubes and Carbon Nanostructures 2010, 18, 137-147. IF(2010)=0.631
I have partially staed the scientific problem (70%), performed the experiments and characterized the products (20%). I estimate my contribution to be 20%.

45. S. Biniak, M. Pakuła, A. Świątkowski, **M. Bystrzejewski**, S. Błażewicz. Influence of high-temperature treatment of granular activated carbon on its structure and electrochemical behavior in aqueous electrolyte solution. Journal of Materials Research 2010, 25, 1617-1626. IF(2010)=1.402
I contributed in the manuscript preparation (20%) and structural analysis of carbon materials by X-ray diffraction and Raman spectroscopy. I estimate my contribution to be 15%.

46. S. Cudziło, A. Huczko, M. Pakuła, S. Biniak, A. Świątkowski, M. Szala, **M. Bystrzejewski**. Physicochemical Properties of Carbon Materials Obtained via Combustion Synthesis of Perchlorinated Hydrocarbons. Carbon Science and Technology, 2010, 3, 131-138. IF(2010)=0.300
I contributed in the manuscript preparation (15%) and structural analysis of carbon materials by X-ray diffraction and Raman spectroscopy. I estimate my contribution to be 10%.

47. M. Soszyński, A. Dąbrowska, **M. Bystrzejewski**, A. Huczko, Combustion Synthesis of One-Dimensional Nanocrystalline Silicon Carbide. Crystal Research and Technology 2010, 45, 1241-1244. IF(2010)=0.948
I acquired and analysed the Raman spectra. I estimate my contribution to be 8%.

48. M. Popławska, Z. Żukowska, S. Cudziło, **M. Bystrzejewski**. *Functionalization of carbon-encapsulated magnetic nanoparticles by cycloaddition of nitrile oxides*. Carbon 2010, 48, 1318-1320. **IF(2010)=4.896**
Szacowany udział własny = 35%; liczba cytowań:5
I contributed in synthesis of carbon-encapsulated iron nanoparticles, analyzing the TGA curves and writing the manuscript (30%). I estimate my contribution to be 35%.

49. M.A. Cywińska, I.P. Grudziński, A. Cieszanowski, **M. Bystrzejewski**, M. Popławska. Nanoplatforms for magnetic resonance imaging of cancer. Polish Journal of Radiology 2011, 76, 28-36. **IF(2011)=0.234**
I have discussed the section on physical properties of magnetic nanoparticles and prepared Figure 2. I estimate my contribution to be 10%.

50. A. Huczko, A. Dąbrowska, M. Soszyński, N. Maryan, **M. Bystrzejewski**, H. Lange, P. Baranowski, T. Gemming, A. Bachmatiuk, M. Rümmeli. Ultra-fast self-catalytic growth of silicon carbide nanowires. Journal of Materials Research 2011, 26, 3065-3071. IF=1.434
I acquired and analysed the Raman spectra. I estimate my contribution to be 5%.

51. W. Kiciński, M. Norek, **M. Bystrzejewski**, Monolithic porous graphitic carbons obtained through catalytic graphitization of carbon xerogels, Journal of Physics and Chemistry of Solids 2013, 74, 101-109. IF(2012)=1.527

I contributed in phase composition and structural studies of carbon materials. I estimate my contribution to be 10%.

52. W. Bratek, A. Świątkowski, M. Pakuła, S. Biniak, **M. Bystrzejewski**, R. Szmigielski. Characteristics of activated carbon prepared from waste PET by carbon dioxide activation. Journal of Analytical and Applied Pyrolysis 2013, 100, 192-198. IF(2012)=2.560

I contributed in the structural analysis of activated carbon. I estimate my contribution to be 15%.

53. W. Kiciński, M. Norek, M.H. Ruemmeli, T. Gemming, **M. Bystrzejewski**, Synthesis of porous graphitic materials obtained from carbonization of xerogels doped with transition metal salts, Bulletin of Materials Science, in press. IF(2012)=0.584

I acquired and analyzed the Raman spectra. I estimate my contribution to be 10%.

54. A. Huczko, M. Kurcz, P. Baranowski, **M. Bystrzejewski**, A. Bhattarai, S. Dyjak, R. Bhatta, B. Pokhrel, B.P. Kafle, Fast combustion synthesis and characterization of YAG:Ce+3 garnet nanopowders, Physica Status Solidi B, in press. IF(2012)=1.489

I contributed in phase composition studies by X-ray diffraction. I estimate my contribution to be 10%.

55. I.P. Grudziński, **M. Bystrzejewski**, M.A. Cywińska, A. Kosmider, M. Popławska, A. Cieszanowski, A. Ostrowska, Cytotoxicity Evaluation of Carbon-Encapsulated Iron Nanoparticles in Melanoma Cells and Dermal Fibroblasts. Journal of Nanoparticle Research 2013, 15, 1835 (1-18). **IF(2012)=2.175**

I have synthesized and characterized carbon-encapsulated iron nanoparticles, written a part of the manuscript (10%) and analyzed results (10%). I estimate my contribution to be 15%.

56. I. Grudzinski , **M. Bystrzejewski**, M. Cywinska, A. Kosmider, M. Poplawska, A. Cieszanowski, Z. Fijalek, A. Ostrowska, A. Parzonko, Assessing carbon-encapsulated iron nanoparticles cytotoxicity in Lewis lung carcinoma, Journal of Applied Toxicology 2014, 34, 380-394. IF(2012)=2.597

I have synthesized and characterized carbon-encapsulated iron nanoparticles. I have also developed a model describing the internalization of carbon encapsulates into cells. I estimate my contribution to be 20%.

57. I.P. Grudzinski, **M. Bystrzejewski**, M.A. Cywinska, A. Kosmider, M. Poplawska, A.Cieszanowski, Z. Fijalek, A. Ostrowska, Comparative cytotoxicity studies of carbon-encapsulated iron nanoparticles tested at different stages of synthesis in murine glioma cells, Colloids and Surfaces B 2014, 117, 135-143. IF(2012)=3.554

I have synthesized and characterized carbon-encapsulated iron nanoparticles, written a part of the manuscript (10%) and analyzed results (10%). I estimate my contribution to be 15%.

58. W. Kiciński, M. Szala, **M. Bystrzejewski**, Sulfur-doped Porous Carbons: Synthesis and Applications, Carbon, 2014, 68, 1-32. IF(2012)=5.868

I contributed in manuscript preparation (10%) and discussion on synthesis methods of porous carbons doped with sulphur. I estimate my contribution to be 10%.

59. A.M. Nowicka, A. Kowalczyk, M. Donten, M.L. Donten, **M. Bystrzejewski**, Z. Stojek. Carbon-encapsulated iron nanoparticles as ferromagnetic matrix for oxygen reduction in absence and presence of immobilized laccase. Electrochimica Acta, 2014, 126, 115-121IF(2012)=3.777

I have synthesized and characterized carbon-encapsulated iron nanoparticles and measured the distribution of magnetic field induction. I estimate my contribution to be 10%.

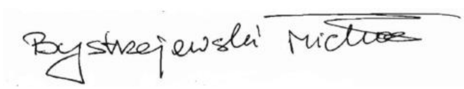
60. M. Poplawska, **M. Bystrzejewski**, I.P. Grudzinski, M.A. Cywinska, J. Ostapko, A.Cieszanowski, Immobilization of gamma globulins and polyclonal antibodies of class IgG onto carbon-encapsulated iron nanoparticles functionalized with various surface linkers. Carbon 2014, 74, 180-194. IF(2012)=5.868

I have synthesized and characterized carbon-encapsulated iron nanoparticles and developed a model for evaluation of the content of immobilized biomolecules. I estimate my contribution to be 15%.

61. O. Łabędź, A. Grabias, W. Kaszuwara, **M. Bystrzejewski**, Influence of Al on synthesis and properties of carbon-encapsulated iron nanoparticles. Journal of Alloys and Compounds 2014, 603, 230-238. IF(2012)=2.390

I have stated the scientific problem, written the manuscript (75%), analyzed the results, made the conclusions. I estimate my contribution to be 70%.

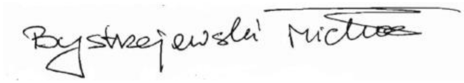
Total impact factor of the above publications: 122.732



B) Inventions and industrial/craft patterns subjected to protection and presented at international or domestic exhibitions:

1. H. Krawczyk, M. Popławska, **M. Bystrzejewski**, The synthesis method of 5-hydroxycreatinine and N-methylguanidine, Patent PL nr 214495 z dnia 30 sierpnia 2013 r.

I synthesized carbon nanotubes used in synthesis of compounds described in the invention. I estimate my contribution to be 10%.



C) Monographs, scientific publications in international and domestic journals other than included in point IB:

1. A. Huczko, **M. Bystrzejewski**, „Świat Nanotechnologii: Fulereny 20 lat później", Wydawnictwa Uniwersytetu Warszawskiego, Warszawa 2007, ISBN 9788323503620

I have written the following chapters: 2, 5, 6 and 10. I estimate my contribution to be 40%.

2. **M. Bystrzejewsk**i, A. Huczko, H. Lange, P. Baranowski, J. Kozubowski, M. Woźniak, M. Leonowicz, W. Kaszuwara. *New Carbon Nanostructures: Onions, Giant-Fullerenes, Encapsulates, Peapods*. Wiadomości Chemiczne 2004, 58, 163-202.

I have partially written the manuscript (90%), searched and analysed the cited articles (70%). I estimate my contribution to be 60%.

3. A. Huczko, A. Sadowska, **M. Bystrzejewski**, H. Lange, J. Golimowski, B. Krasnodębska – Ostręga, G. Soucy, G. Cota – Sanchez, *Plasmachemical processing of postincineration solid wastes. Efficiency of plasma melting of wastes*. Chemia i Inzynieria Ekologiczna 2004, 11, 189-198.

I have provided technical support in experimental works. I estimate my contribution to be 5%.

4. A. Huczko, A. Sadowska, **M. Bystrzejewski,** H. Lange, J. Golimowski, B. Krasnodębska – Ostręga, G. Soucy, G. Cota – Sanchez. *Plasmachemical processing of postincineration solid wastes. Physical and chemical transformations of wastes*. Chemia i Inzynieria Ekologiczna 2005, 12, 7-16.

I have analysed the electron microscopy images. I estimate my contribution to be 5%.

5. **M. Bystrzejewski**, A. Huczko. Carbon Nanotubes Purification Processes. Wiadomości Chemiczne 2005, 59, 537-555.

I have stated the scientific problem, searched the cited references and written the whole manuscript. I estimate my contribution to be 95%.

6. A. Huczko, S. Cudziło, **M. Bystrzejewski**, H. Lange, M. Szala. *Fabrication of nanostructural materials in a combustion synthesis route*. Biuletyn WAT 2005, 54, 57-71.

I have analysed the electron microscopy images. I estimate my contribution to be 5%.

7. E. Kowalska, P. Kowalczyk, J. Radomska, E. Czerwosz, H. Wronka, **M. Bystrzejewski**. *Wpływ procesu wygrzewania na niektóre właściwości nanorurek węglowych,* Prace Naukowe P.W., Elektronika z.153, str. 187-191, Technika Próżni i Technologie Próżniowe, Oficyna Wydawnicza PW 2005.

I have analysed the thermal analysis curves. I estimate my contribution to be 5%.

8. **M. Bystrzejewski**, T. Pichler, M. Rummeli. *Chemical functionalization of carbon nanotubes.* Wiadomości Chemiczne 2006, 60, 569-608.

I have stated the scientific problem, searched the cited references and written the whole manuscript. I estimate my contribution to be 90%.

D) Collective works, collection catalogs, documentation of research, expert analyses, artistic works

N.A.

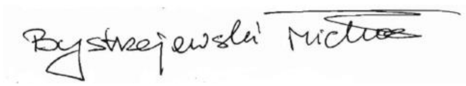
E) Total Impact Factor according to the JCR list: 164.323

F) Total numer of citations according to Web of Science (WoS): 665 (without self-citations); 853 (with self-citations)

G) Hirsch index Web of Science (WoS): 15

H) Managing and participation in internation and domestic research projects::

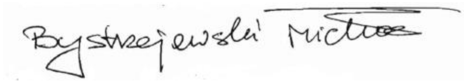
- Project LIDER NCBiR 527/L-4/2012 (2013-2016). New mobile nanocomposites of high corrosion resistance for removal of organics and heavy metal ions. **Project Leader**
- Project MNiSW N204 096 31/2160 (2006-2009). Carbon nanotubes: new synthesis methods and their optimization, and studies of the growth mechanism. **Main Contractor.**
- Project MNiSW N204 118 32 (2006-2008). Synthesis of carbon nanotubes from carbon materials of various graphitization degree. **Main Contractor.**
- Project MNiSW N204 132137 (2009-2011). Synthesis and studies of mobile nanocrystalline sorbents of heavy metal ions. **Project Leader.**
- Project MNiSW N N518 381737 (2009-2012). New nanostructural superparamagnetic materials in molecular imaging of cancer tumors. **Main Contractor.**
- Project financed from the national programme Innovative Economy (2009-2012). Development of technology for new generation of hydrogen sensor and its application in over-normative conditions. **Main Contractor.**
- Project MNiSW N N204 248140 (2011- 2014). Magnetic hybrid carbon nanomaterials – mobile sorbent for organic compounds removal. **Main Contractor.**
- Project IUVENTPLUS PLUS IP2011 006071 (2012 - 2014). Studies and moficiation of corrosion resistance of magnetic hybrid carbon nanomaterials. **Project Leader**
- Project NCN (2013-2016). New methods for synthesis of exfoliated graphite and its transformation into graphene. **Main Contractor.**
- Projekt INNOTECH NCBiR (2012-2015). New lead-acid battery based on a reticulated vitreous carbon. **Main Contractor.**
- Project LIDER NCBiR 527/L-4/2012 (2013-2016). New mobile nanocomposites of high corrosion resistance for removal of organics and heavy metal ions. **Project Leader**



I) International and domestic awards for scientific or artistic activity:

1) 2007 The Znatowicz Award (Polish Chemical Society) for the best review paper (Funkcjonalizacja chemiczna nanorurek węglowych) published in Wiadomości Chemiczne in 2006
2) START stipend (2007 and 2008) for young researchers, Foundation for the Polish Science
3) 2010 Award in the competition „Cudze chwalicie swego nie znacie – promocja osiągnięć nauki polskiej" (www.topnauka.pl)

4) 2010 The A. Grabowskiego award (Univesrity of Warsaw) for a series of papers on synthesis and applications of hybrid magnetic carbon nanomaterials
5) Award from the editorial office of the New Carbon Materials Journal for the best paper published by a researcher below 35 years old (see [H7])
6) 2011 scientific stipedn from the Ministry of Science and Higher Education for young scientists
7) 2011 Certificate of Appreciation from the American Chemical Society for valuable contribution in the peer review of manuscripts submitted to ACS journals



J) Oral presentations at international and domestic scientific conferences:

1. E. Kowalska, J. Radomska, E. Czerwosz, P. Kowalczyk, H. Wronka, **M. Bystrzejewski**, „Properties of carbon nanotubes synthesized by ferrocene-xylene mixture cvd method", 9th Conference on Thermal Analysis and Calorimetry. Zakopane 2003.

2. **M. Bystrzejewski**, H. Lange, A. Huczko, Z. Karoly, L. Gal, „RF plasma synthesis of carbon encapsulates", VIII Ogólnopolskie Sympozjum Chemii Plazmy, Słok k. Bełchatowa, 2004.

3. J. Drabik, E. Pawelec, A. Huczko, H. Lange, **M. Bystrzejewski**, "Oxidation Resistance of Fullerene-containing Vegetable Oils", Carbon Materials. Theorecital and Experimental Aspects. International Symposium. Budapest, 2005.

4. **M. Bystrzejewski**, „Carbon Encapsulation of Magnetic Nanoparticles: Synthesis, Characterization and Applications", ESF Exploratory Workshop: Carbon Based Nanostructured Composite Films, Gdańsk, 2006.

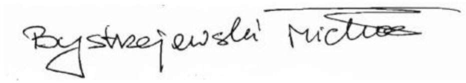
5. **M. Bystrzejewski**, A. Huczko, H. Lange, W. Kaszuwara, S. Cudziło, "Carbon-encapsulated magnetic nanoparticles spontaneously formed by thermolysis route", 8th Biennal International Workshop Fullerenes and Atomic Clusters, St. Petersburg, Russia, 2007.

6. **M. Bystrzejewski**, "Carbon-encapsulated magnetic nanoparticles: advanced nanomaterials for biomedical applications", Biopowders Conference, Advances in the Powder Technology, Budapest, Hungary, 2007.

7. **M. Bystrzejewski**, "Hybrydowe magnetyczne nanokompozyty węglowe: synteza i zastosowanie", V Konferencja Naukowo-Techniczna: Materiały Węglowe i Kompozyty Polimerowe, Ustroń, 2010.

8. **M. Bystrzejewski**, „Core-shell magnetic carbon nanoparticles: mobile platforms for sorption of heavy metals and aromatic compounds", Workshop on Nanomaterials in Chemical and Biomedical Applications, Warszawa, 2012.

9. **M. Bystrzejewski**, "Recent advances in synthesis and applications of carbon-encapsulated magnetic nanoparticles", VI Krajowa Konferencja Nanotechnologii, Szczecin, 2013.



III. Teaching and popularization achievements and information on international collaborations of the applicant

A) Participation in European, other international and domestic programs:

N.A.

B) Active participation in international and domestic scientific conferences:

Beside the talks listed in point II J, I participated in the following scientific conferences and presented the results as a poster presentation:

1. **M. Bystrzejewski**, A. Huczko, H. Lange, „Arc plasma route to magnetic carbon-encapsulated nanoparticles for biomedical applications", EMRS Fall Meeting, Warszawa, 2004.
2. J. Yi-Zheng, **M. Bystrzejewski**, A. Huczko, C. Gao, W.K. Hsu, C.Y. Lee, Y.Q. Zhu, M.J. Roe, G. Walker, H.W. Kroto, D.R.M. Walton, "Synthesis and characterization of carbon spheres from direct pyrolysis of hydrocarbons", Nanotec 2004, Batz sur Mer, Francja, 2004.
3. **M. Bystrzejewski**, H. Lange, A. Huczko, M. Ruemelli, T. Gemming, "B-doped MWCNT production by arc discharge in water", 7th Biennal International Workshop Fullerenes and Atomic Clusters, St. Petersburg, Russia, 2007.
4. **M. Bystrzejewski**, H. Lange, A. Huczko, M. Ruemelli, T. Gemming, "Production of B-doped multiwalled carbon nanotubes by arc discharge in water" 17th International Conference on Plasma Chemistry, SPC 17, Toronto, Canada, 2005.
5. **M. Bystrzejewski**, S. Cudziło, A. Huczko, H. Lange, „Thermal stability of carbon-encapsulated Fe-Nd-B nanoparticles", EMRS 2005 Fall Meeiting, Warszawa, 2005.
6. **M. Bystrzejewski**, M. H. Rummeli, H. Lange, A. Huczko, T. Pichler „Single-walled carbon nanotube synthesis: a comparison of laser ablation and carbon arc routes", Nasa/Rice Nucleation and Growth Workshop III, USA, Texas, Canyon of the Eagles, 2007.
7. **M. Bystrzejewski**, M. Strawski, A. Huczko, H. Lange, „Morphology and structure of collapsed carbon nanoparticles", EMRS Fall Meeting, Warszawa, 2007.

8. **M. Bystrzejewski**, H. Lange, A. Huczko, Z. Karoly, J. Szepvolgyi, „Continuous Synthesis of Carbon-Encapsulated Magnetic Nanoparticles by RF Thermal Plasma", 23rd Symposium on Plasma Physics and Technology Prague, Czech Republic, 2008.

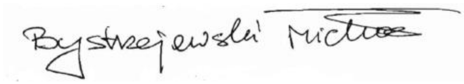
9. **M. Bystrzejewski**, A. Huczko, P. Byszewki, M.H. Rummeli, T. Gemming, H. Lange, "Systematic studies on SWCNTs synthesis from aliphatic alcohols by CVD floating catalyst method", Diamond Conference, 2008, Sitges, Spain, 2008.

10. **M. Bystrzejewski**, T. Gemming, B. Buchner, A. Huczko, H. Lange, M.H. Rummeli, "Dispersing and separation of multi-wall carbon nanotubes using various surfactants". 4th International Conference on Carbon Based Nanocomposites, Hamburg, Germany, 2009.

11. **M. Bystrzejewski**, K. Pyrzyńska, Z. Karoly, J. Szepvolgyi, „Synthesis and environmental applications of iron nanoparticles tightly encapsulated in carbon shells via RF thermal plasma", 24th Symposium on Plasma Physics and Technology, Prauge, Czech Republic, 2010.

12. **M. Bystrzejewski**, O. Łabędź, W. Kaszuwara, J. Borysiuk, A. Huczko, H. Lange „Synthesis of core-shell carbon-encapsulated iron nanoparticles with controlled size and magnetic properties", International Conference of Superconductivity and Magnetism, Istanbul, Turkey, 2012.

13. **M. Bystrzejewski**, Z. Karoly, J. Szepvolgyi, W. Kaszuwara, O. Łabędź, A. Huczko, H. Lange, „Continuous thermal plasma synthesis of carbon-encapsulated iron nanoparticles with ferrite stabilizing elements. 5th Central European Symposium on Plasma Chemistry, Balatonalmadi, Hungary, 2013.

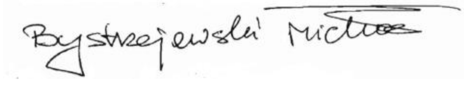


C) Participation in organizing committees of international and domestics scientific conferences

N.A.

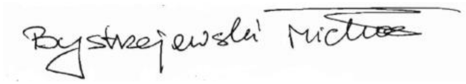
D) Awards and distinctions other than listed in point II H

- 2008 Scientific Award (Dept of Chemistry, University of Warsaw) for the published book „Fulereny 20 lat później"
- 2009 scientific stipend in the frames of the programme "The modern university" (University of Warsaw)



E) Participation in research networks and consortia:

1. Centre for Pre-clinical Research and Technology (a joint project of University of Warsaw, Warsaw University of Technology, Medical University of Warsaw)



F) Managing in projects realized with cooperation with scientists from other Polish and international sites, as well as in cooperation with private companies

N.A.

G) Participation in editorial committes and editorial boards of scientific journals

N.A.

H) Participation in international and domestics organisations and scientific societies

N.A.

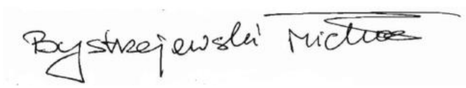
I) Teaching achievements and achievements in popularization of science or art

Course name:

- Physical Chemistry: Tutorials (Undergraduate studies in Chemistry, Nanostructure Engineering and Energetics and Nuclear Chemistry)
- Physical Chemistry: Laboratory (Undergraduate studies in Chemistry, Nanostructure Engineering and Energetics and Nuclear Chemistry)
- Laboratory on Instrumental Analysis and Spectroscopy (Undergraduate studies in Nanostructure Engineering)
- Advanced Physical Chemistry: Laboratory (Graduate studies in Chemistry)
- Lecture: „Carbon nanomaterials" (Undergraduate studies in Nanostructure Engineering)

Other:

- In 2009 and 2010 I was a member of a group, which developed an education program for studies Nanostructure Engineering. I have elaborated and compiled a conspectus for classes on Physical Chemistry: Laboratory.
- I have prepared a script for the new laboratory classes „Thermal Analysis of carbon and ceramic nanomaterials" (for students of Nanostructures Engineering)



J) Scientific advice to students:

Supervising BSc theses:

1) M. Fronczak, „Badanie stabilności korozyjnej magnetycznych nanokapsułek węglowych", Wydział Chemii UW, W-wa 2012
2) P. Strachowski, „Adsorpcja fenoli i pochodnych na węglu aktywnym, nanorurkach węglowych i magnetycznych nanokapsułkach węglowych", Wydział Chemii UW, W-wa 2012
3) M. Kowalik „Utlenianie powierzchniowe węgla aktywnego w wyładowaniu jarzeniowym prądu przemiennego", Wydział Chemii UW, W-wa 2014 (obrona w czerwcu 2014)
4) M. Kowalczyk „Otrzymywanie i badanie wodnych zawiesin magnetycznych nanokapsułek węglowych", Wydział Chemii UW, W-wa 2014 (obrona w czerwcu 2014)
5) M. Krawczyk „Optymalizacja rozpuszczalności wielkocząsteczkowego poli(tereftalanu etylenu) w układzie fenol-tetrachloroetylen", Wydział Chemii UW, W-wa 2014 (obrona w czerwcu 2014)

Supervising MSc theses:

1) M. Soszyński, „Optymalizacja syntezy wybranych heterogennych nanomateriałów węglowych w plazmie termicznej", Wydział Chemii UW, W-wa 2009
2) K. Barszcz, „Otrzymywanie magnetycznych nanokapsułek węglowych w strumieniu plazmy termicznej", Wydział Chemii UW, W-wa 2010
3) M. Fronczak „Badania nad poprawą odporności korozyjnej magnetycznych nanokapsułek węglowych", Wydział Chemii UW, W-wa 2014 (obrona w czerwcu 2014)
4) P. Strachowski „Badanie adsorpcji równowagowej i kinetyki sorpcji fenolu i pochodnych na węglach aktywnych, nanorurkach węglowych i magnetycznych nanokapsułkach węglowych", Wydział Chemii UW, W-wa 2014 (obrona w czerwcu 2014)

Reviewing BSc and MSc theses:

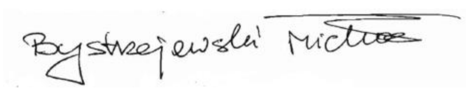
- *BSc theses – 1 (2012 r.)*
- *MSc theses – 1 (2013 r.)*

Popularization of science:

1. Lecture given in the frames of the XI Festival of Science „The world of nanotechnology: fullerenes, nanooonions, carbon encapsulates – a bridge between molecules and monocrystals" Sept. 2007

2. Lecture for the Polish Children's Fund „Can carbon be magnetic? A scientific excursion from fullerenes and carbon nanotubes to magnetic carbon encapsulates" – February 2008 r.

3. Lecture for the „Curious chemistry series" „Physics and Chemistry of Carbon 1985-2009: great discoveries, new perspectives", March 2010 r.

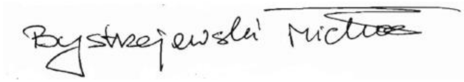


K) Scientific assistance to PhD students

N.A.

L) Interships in international and domestic academic or research centres

- Leibniz Institute for Solid State Research (prof. dr. Mark Rummeli), Dresden, Germany: 18 months in 2006-2010. Aim: a partial realization of experimental work on PhD thesis. Joint research projects. Result of the cooperation: 14 joint papers. The collaboration continues until the present.
- Chemical Research Center, Hungarian Academy of Sciences (prof. dr. Janos Szepvolgyi). 1-2 week visits in 2003-2012 (5 visits). Aim: collaboration in the field of thermal plasma synthesis of carbon nanomaterials. Result: 3 join papers. The collaboration continues until the present



M) Expert opinions or other contracted studies

N.A.

N) Participation in expert panels and juries

N.A.

O) Reviewing international and domestic research projects

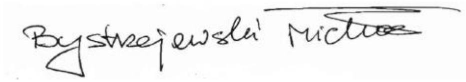
N.A.

P) Reviewing scientific papers in domestic and international journals

Since 2006 I have reviewed more than 90 original manuscripts related with chemistry of materials, plasma chemistry and solid state physics. I reviewed the manuscript submitted to the editorial offices of the journals, which are published by the largest publishing houses, i.e. American Chemical Society, Elsevier, Willey, Springer. The table below presents the number of reviewed manuscript for selected journals.

Journal	**IF (2012 r.)**	**Manuscripts reviewed**
ACS Nano	12.062	3
Carbon	5.868	7
Langmuir	4.187	2
Nanotechnology	3.842	6

New Journal of Chemistry	2.966	2
Fullerenes, Nanotubes and Carbon Nanostructures	0.764	5
Journal of Hazardous Materials	3.925	4
Journal of Alloys and Compounds	2.390	4
Materials Letters	2.224	8
Journal of Physics D: Applied Physics	2.528	2



Q) Other achievements

- Manager of Laboratory of structural and physic-chemical studies in Centre for Preclinical Research and Technology (CePT)
- A member of the commission for the library sources and computerization
- A member of the commission for the recruitment for PhD studies