
Doctoral Thesis of Włodzimierz Czepa

“Synthesis and functionalization of low-dimensional materials towards high-performance supercapacitors”

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Thesis assessment

The research work of Włodzimierz Czepa was done in the Faculty of Chemistry at Adam Mickiewicz University in Poznań. His work was supervised by Prof. Artur Ciesielski a recognized expert in the field of science, in the discipline of chemical science. The work had led to the Ph.D. Dissertation of Candidate which I have the honor to review. The PhD assessment is a result of the invitation of Scientific Council of Chemistry Science in Adam Mickiewicz University in Poznań.

The doctoral dissertation was submitted in the form of four thematically coherent scientific papers published in scientific highly-recognized journals. All of them are placed in the discipline of chemical

science with strong touch of materials chemistry and material science. The dissertation comprises 70 pages and copy of publications. The 70 pages are dedicated to List of abbreviations, abstract (in English and in Polish), list of publications included in dissertation, scientific achievements of Candidate, description of publications included in dissertation and author contribution. The thesis is well balanced and shows a good distribution of pages for each section. The scientific achievements of Włodzimierz Czepa are impressive. The list of his publications shows excellent research activity in various but related fields and scientific projects. He published 10 manuscripts (not included in the dissertation) with high impact factors. Among them, there are the highest quality journals in the field e.g. Carbon, Advanced Functional Materials or Energy Storage Materials. Additionally, He presented his research work during 10 national and international conferences. His achievements have been well rewarded in the form of fellowships and awards. Among them, He Fellowship of Minister for excellent young researchers is the most impressive. What is crucial his research experience has been broadened during 5 international internships in the Nanochemistry Laboratory of prof. Paulo Samori in Strasbourg in France.

In the section of Description of publications included in the dissertation, the PhD Candidate has guided the reader through the research topic of 2D nanomaterials with focus on graphene. In [P1] which is a review paper Mr Włodzimierz Czepa was responsible for writing the chapter on “(Bio)molecular sensors”. However, the content of Author Contribution Form is designed like for research paper. Other included activities are planning of the study (in review study is not really planned), discussion of the results and interpretation of data (this is also already provided by authors of papers included in review). However, the manuscript is crucial to provide great overview on 2D nanomaterials and highlights their potential in electrochemistry. [P2] is a research paper dedicated to functionalization of graphene via polyhedral oligosilsequioxane (POSS) in order to induce enhanced porosity and interlayer distance crucial for electrolyte transport during storage process in supercapacitors. The electrochemical performance in three-electrode system is superior. However, in order to assess the practical potential the system should be also measured in two-electrode system. This study is missing in the manuscript. Next, in [P3] deals with covalent functionalization of graphene oxide with thioamide polymer in order to enrich the molecular system for boosted

electrochemical response. Here, the two-electrode system of coin cell type was assessed. The fabricated device revealed fantastic energy density and robustness in both acidic and organic electrolytes. Finally, [P4] turns to 1D molecular system based on ultralong copper sulfide nanowires for 2 electrode system in organic electrolyte for wider voltage window. The promising results have been achieved, however, the stability performance could be improved. The Author Contribution Form clearly indicates significant input of the PhD Candidate to the creation of these scientific papers. Especially, in P2 and P3 the role of Włodzimierz Czepa is impressive because it includes His role in each step towards manuscripts design: planning of the study, synthesis of electrode material, deep physicochemical characterization, electrochemical study performance, writing of the manuscript and revision.

In General Introduction and Motivation section some information is confusing or missing:

- in approaches of modification of GO- the criteria of them are not clear. 1 and 2 approach is clear – it is related to sort of interaction (physical or chemical) but 3rd one is not clear (hybrid?). Please clarify.
- the AFM is not included but it is crucial microscopic tool to investigate 2D materials. Why?
- in the section describing energy storage devices hybrid supercapacitors are not mentioned. This class of supercapacitors (metal ion hybrid capacitors) is one of the most promising in terms of practical applications as they meet the performance of supercapacitors and batteries such as high power density, high energy density and long life span.

Concluding, the doctoral dissertation represents a written work based on a collection of 4 published and thematically related scientific articles which are an independent and separate part of a collective work stated in Author Contribution Form. The doctoral dissertation was prepared in English language with the abstract in Polish language. It is worth to emphasize the high quality of the international journals where the research is published what is related with their high impact and future citations.

Additionally, reading the Candidate list of all publications, I observed that Włodzimierz Czepa also developed contacts abroad leading to collaborations with foreign scientific groups. These are very important skills for a young scientist. What is more, the list shows that He is open-minded and scientifically able to cooperate in various related fields what proven by his work in many research projects.

The doctoral thesis of Włodzimierz Czepa presents a significant amount of original and innovative work. Therefore, I suggest the Scientific Council of the Faculty of Chemistry of Adam Mickiewicz University in Poznań admission of Włodzimierz Czepa to the next stage which is the public defense of her doctoral thesis. I formally declare that I accept the thesis as it is.

Additionally, due to the described outstanding scientific results, I recommend this thesis for Award for Excellence.



(Prof. Ewa Mijowska)