EXPERT CONCLUSION

PhD Thesis "Synthesis & Application of Membrane Technologies for Desalination of Sea Water" by Makpal Seitzhanova

1/ The relevance of the research topic and its relationship with general scientific and national programs

New material based on raw materials traditional to the country such rice husk leads to implementation of new technologies with higher level of processing. As expert, I could confirm its importance and relevance to the current national research aims, namely raw wasting materials could be potentially conversed to technically applicable and commercially valuable product such as graphene.

2/ Scientific results in the framework of the requirements for PhD thesis

Scientific results made by the applicant demonstrates new obvious scientific and technological novelties, such as new graphene-like materials with determined properties and applied process technologically constructed for desalination of sea waters. Upon new results I expertise full correspondence of PhD thesis to the requirements for PhD degree defense. Namely, the most significant results of the thesis lead to:

1. Finding that carbonization and activation of rice husk makes formation of a mixture of graphene layers, moreover the relative amount of the graphene component could be increases upon conditions while the number of layers remains unchangeable.
2. Revealing that membranes based on the synthesized graphene materials desalinate seawater till 99% purification.

3/ The level of validity and reliability of each scientific results, provisions and the conclusions formulated by the applicant in the PhD thesis

The applicant postulated 4 main provision of the work and upon the provisions 3 novel research results were formulated. All results are fully confirmed by investigation and eventually summarized in the conclusion. As expert, I confirm validity and reliability of all formulated and postulated sentences by the applicant. Each scientific results, conclusions and provisions formulated in the thesis is clearly justified and aimed at achieving the objectives and the main goal, obtaining new graphene materials from rice husks, studying their physic-chemical performances and applying for desalination of sea water. The reliability and plausibility of the

results obtained is not doubt due to the competent choice of modern research methods aimed at solving tasks set in the PhD thesis. The results obtained are fully interpreted in the context of the modern achievements in the area of nanomaterials, which allows me to judge the high degree of validity of the thesis conclusions.

4/ The level of novelty of each scientific results formulated in PhD thesis

All 3 novel research results are organically produced by applicant research investigation and are scientifically approved and plausible. Upon analyzed PhD thesis I make conclusion that the results are definitely novel and scientifically proved. The novelties in the thesis are fully confirmed by scientific data, physical and chemical analysis facts, as well as works implemented in her research, which were proved by various methods such as DLS, TEM, SEM, NMR, XRD, ICP-MS, FTIR and Raman, TGA/DSC.

5/ Assessment of the internal unity of results

Inferences were formulated by the applicant consequently starting from the goal, further to objectives of the PhD work, and the logically to formulation and speculation of the results. So, I could conclude internal unity and consequence of the results in PhD thesis. The results of the research corresponds fully to the aims, objectives of the thesis, as well as follow logically from the stages of the research. All chapters of the thesis are naturally and scientifically interconnected, the conclusions exhaustively reflect the main results fo the study. All experimental results are supported by data of analytical research.

6/ The focus of the results obtained by the applicant on the solution of the relevant actual problem

Two basic solutions were brought by the work such as applied techniques and technology for rice husk processing and secondly application of the new product for sea water desalination. Upon those solutions it could be confirmed by me PhD work actual solutions are highly applicable and relevant. The synthesis of graphene membranes contributes to the sustainable environmental development of the Republic of Kazakhstan. Researches conducted in the thesis allows me to open up the prospects of using the obtained graphene materials as effective, affordable and non-expensive sorbent for post-treatment of wastewater. It should be pointed out that the practical results make a theoretical contribution in the field of nanomaterials and nanotechnology.

7/ Confirmation of sufficient completeness of publication of the main provisions, results, conclusions

Up on investigation the applicant published in cooperation with the co-supervisors 14 scientific papers, all of those are included in PhD thesis. The work is also approved by postal delivery of presentation at several conferences. The main provisions, results, conclusions of the PhD thesis have been published in sufficient volume and has been widely discussed by interested scientific society.

8/ Correspondence of the abstract to the content of the PhD thesis

The abstract reflects fully to all comprehensive work with its results, provisions and conclusions. Annotation of the research made in 3 languages (Kazakh, Russian and English) is clear and concise. The main contents of the thesis in sufficient detail is reflected in the author's abstract. Conclusions in abstract are identical to the dissertation work and in accordance with the requirements established by the Committee on supervision and certification in the field of education and science.

9/ Deficiencies in the contest and design of the PhD thesis

1. in Figure 7 of the dissertation elemental compositions show variation of nitrogen content in structure, obviously nitrogen-containing hydrocarbons which was not discussed by the author and how this organics could spoil desalinating effects of the membranes or could be rinsed from the final material.
2. According to elemental analysis by EDX images the final materials contain high amount of various metals such as K, Na, Ca, Mg, Fe etc which must be removed by rinsing. The author did not mention in the thesis about purification and how metals could worsen sorption performances of the produced membranes.
3. There is no discussion of mechanical characteristics of the produced membranes, the author did not give data of such mechanical performances in order to conclude about mechanical durability of the final membranes.

10/ Compliance with the PhD thesis for passport

PhD thesis are complied to specialty passport and requirements of the major.

11/ The dissertation "Synthesis & Application of Membrane Technologies for Desalination of Sea Water" defending by Makpal Seitzhanova complies fully

with the requirements of Section 2 of the "Rules for awarding academic degrees" of the Committee for Supervision and Certification in the Field of Education and Science of the Republic of Kazakhstan.

Dissertation research work by Makpal SEITZHANOVA entitled: «Synthesis and Application of Membrane Technologies for Desalination of Sea Water», submitted for the scientific degree of Doctor of Philosophy (PhD) is fully accomplished and well-qualified research work. The work manifests its practical significancy and scientific novelty. Aim and scope of the work correspond fully with research area and major 6D074000 – Nanomaterials & Nanotechnology.

In this dissertation research work there are new plausible and reliable scientific results on synthesis of new graphene-like nanomaterials from wasted rice husk.

The dissertation research work is satisfied fully with requirements for PhD thesis in accordance with Clause 2 of the Rule for awards of a scientific degree of the Committee on supervision and certification in the field of education and science, and its author Makpal SEITZHANOVA deserves the award of scientific degree of Doctor of Philosophy (PhD) in research area and major 6D074000 – Nanomaterials & Nanotechnology. I recommend the PhD thesis "Synthesis & Application of Membrane Technologies for Desalination of Sea Water" for defending at the Dissertation Council.

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