

Jury Member Report – Doctor of Philosophy thesis.

Name of Candidate: Nataliya Gvozdik

PhD Program: Materials Science and Engineering

Title of Thesis: Advanced characterization methods of materials and redox mechanisms in flow batteries

Supervisor: Professor Keith Stevenson

Name of the Reviewer:

I confirm the absence of any conflict of interest	Date: 12-09-2022
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The purpose of this report is to obtain an independent review from the members of PhD defense Jury before the thesis defense. The members of PhD defense Jury are asked to submit signed copy of the report at least 30 days prior the thesis defense. The Reviewers are asked to bring a copy of the completed report to the thesis defense and to discuss the contents of each report with each other before the thesis defense.

If the reviewers have any queries about the thesis which they wish to raise in advance, please contact the Chair of the Jury.

Reviewer's Report

Reviewers report should contain the following items:

- Brief evaluation of the thesis quality and overall structure of the dissertation.
- The relevance of the topic of dissertation work to its actual content
- The relevance of the methods used in the dissertation
- The scientific significance of the results obtained and their compliance with the international level and current state of the art
- The relevance of the obtained results to applications (if applicable)
- The quality of publications

The summary of issues to be addressed before/during the thesis defense

The candidate developed new methods for characterisation of flow batteries. In particular, she has developed method of in-situ Raman monitoring of vanadyl oxidation on carbon electrode and elaborated numerical for identification of kinetic battery parameters. Additional benefits from the PhD thesis are determination of the basic parameters for bipolar plate materials for batteries and study of the colloid additives to enhance RFB capacity by nanoimpact technique.

Developed methods can be applied for investigation of other materials potentially to be used in flow batteries. Thus, the study performed by the candidate is of interest to broader scientific community. The publications in established journals also justify the good quality of the PhD research. The title and content of the PhD thesis are relevant to the claimed topic and objectives. The results have been presented with detailed description of experimental and theoretical methods.

There are some points that should be addressed during PhD viva:

1. Table 1.1. The candidate should demonstrate the understanding of interconnection between grid specifications.
2. Introduction part. The hot topic in battery research is to replace one-electron battery to two-electron battery thus doubling the theoretical battery capacity. The candidate should comment this new direction comparing to the RFB approach.
3. Why did RFBs get low attention from industry? What are the current difficulties for their application? Is it possible to use this concept for e-vehicle recharging (like petrol station with energy tanks)?
4. What is the influence of flow speed on the RFB performance?
5. Developed analytical methods should be compared to the existing ones.
6. Why vanadium-based RFBs have been selected; why not other and similar? I have found plenty of publications in WoS describing other redox pairs.
7. What is biologic potentiostat (page 96)? I know Galvani's experiments (already published); is it similar?
8. Why are bipolar materials important? What is about shortcuts?
9. Did you account for capillary effects in your model? Any charge/discharge effect is about interface and the delivery of the material to it.

Provisional Recommendation

I recommend that the candidate should defend the thesis by means of a formal thesis defense

I recommend that the candidate should defend the thesis by means of a formal thesis defense only after appropriate changes would be introduced in candidate's thesis according to the recommendations of the present report

The thesis is not acceptable and I recommend that the candidate be exempt from the formal thesis defense