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Jury Member Report – Doctor of Philosophy thesis.

Name of Candidate: Vahid Ramezankhani

PhD Program: Materials Science and Engineering

Title of Thesis: Design of potassium-ion batteries using novel organic electrode materials

Supervisor: Professor Stanislav S. Fedotov

Co-supervisor:

Name of the Reviewer: Smagul Karazhanov, Full Professor

I confirm the absence of any conflict of interest (Alternatively, Reviewer can formulate a possible conflict)	**Date: 30-09-2023**

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:

The dissertation exhibits a robust organization, and presents itself as a meticulously planned and skillfully executed research work.
The dissertation's topic and content are closely aligned, demonstrating a clear and logical progression from the overarching theme of K-ion storage to the specific focus on the specific family of organic materials, carbonyl-containing organic redox-active materials. The author's deep understanding of the challenges associated with this material family and the innovative solutions proposed to mitigate these challenges underscore the dissertation's relevance and significance in the field of energy storage and battery technology. The techniques detailed in the dissertation, notably those pertaining to the assembly of batteries, the preparation of electrodes, and the investigation of mechanisms, hold significant relevance and are essential components of the overall research undertaking. They enable the practical examination of the suitability of the new organic electrode materials for K-ion batteries, ensuring that the results are firmly rooted in rigorous experimental procedures. This methodical precision enhances the dissertation's robustness and its potential to make a meaningful impact in the field of energy storage and battery technology. The scientific importance of the outcomes achieved in this dissertation is substantial and showcases a commendable alignment with global standards and the most current advancements in energy storage. Chapter 6, which juxtaposes the acquired results with the remarkable findings published in scientific literature, stands as proof of the research's exceptional quality. The author's assertion that the obtained results rank among the top in terms of cyclability, energy density, and discharge capacity is particularly remarkable. Such discoveries carry significant scientific weight as they not only affirm the effectiveness of the innovative organic electrode materials for potassium-ion batteries but also contribute to pushing the boundaries of performance, thus advancing the field. Attaining results that compete with or surpass those documented in leading scientific publications underscores the dissertation's significance and its potential to influence the development of sustainable global energy storage solutions. The results obtained carry substantial practical implications, especially within the realm of potassium-ion batteries. Vahid's identification of an ideal molecular structure for use as an anode material in these batteries represents a pivotal advancement toward the creation of energy storage solutions that are both more effective and sustainable. Additionally, the successful modification of the electrode composition, reducing the contribution of carbon nanofiller, stands out as a noteworthy accomplishment, aligning well with the practical requirements of real-world battery applications. Furthermore, Vahid's suggestions for further optimizing this family of materials in potassium-ion batteries emphasize the practical utility of the research, offering valuable insights for future advancements in energy storage technology. In summary, these findings are not only of significant scientific importance but also hold great promise for practical applications in the development of more efficient and cost-effective potassium-ion batteries. The quality of Vahid's publications is exceptionally high, as evidenced by their placement in top Q1 journals, with impact factors beyond 9. I noticed from Google Scholar that he has other publications that he does not include in the dissertation.

Summary of issues to be addressed before/during the thesis defense

I'd like to point out that the current state of the dissertation is acceptable. However, I have a question: Have you tested the concept of pairing P7 with high-potential inorganic materials, possibly in lithium-full cells?