DIPARTIMENTO DI CHIMICA "GIACOMO CIAMICIAN"

Bologna 16/08/2021

OBJECT: Evaluation of PhD Thesis "Studies of capacitive and faradaic processes in electrochemical capacitors and in redox flow batteries" by Justyna Piwek, Institute of Chemistry and Technical Electrochemistry at Poznan University of Technology.

This is an excellent work that addresses a very challenging research on the role of carbon surface properties in the supercapacitor and redox flow battery performance, including a novel system, i.e. the dual-circuit vanadium redox flow battery.

The experimental results are original and of high significance and might pave the way towards the design of novel, greener electrochemical energy conversion/storage devices. Specifically, this work can have a high impact on the development of long-lasting supercapacitors working with aqueous electrolytes and on the improvement of the energy efficiency of dual-circuit vanadium redox flow batteries.

The candidate demonstrates a deep knowledge about the research on carbonaceous electrode materials, on the electrolytes, on the strategies to get insight into the ageing mechanisms of supercapacitors and vanadium redox flow batteries, and on their chemical-physical properties and on the techniques used for their investigation.

The work is excellently described and the dissertation very well organized. The document is of high standard with respect to technical detail and the language is appropriate. The introduction chapters are exhaustive and review the recent research works on the Thesis topics. The challenges in the study of ageing processes and on the development of system components are deeply discussed, which clearly proves high familiarity of the candidate with the field of research in question. Furthermore, the candidate has adequately mentioned and interpreted the relevant literature on her dissertation topic.

Research approaches and results are original and innovative and rely on different

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activities, from the analyses of different supercapacitor ageing test protocols and the proposal of a new one based on alternative floating, to the demonstration of the possible reuse of the supercapacitor negative electrodes of aged cells to assemble new ones, to the treatment of carbon felts by molten salt oxidation method for a use in dual-circuit vanadium redox flow batteries.

The systems are deeply studied by combining chemical physical and morphological analyses and electrochemical investigations. The methods include advanced techniques like N_2 sorption at 77K, scanning electron microscopy, elemental analysis, Raman and X-ray Photoelectron Spectroscopy, along with cyclic voltammetry, floating and cycling tests, and electrochemical impedance spectroscopy.

The scientific rigor with which these studies are reported and commented demonstrate the high skills acquired by the PhD student in the different techniques of characterization of supercapacitor and redox flow battery electrode materials. The conclusive part of the dissertation demonstrates that the candidate has an outstanding ability to critically examine and compare with literature the achieved research results. This skill also permit to the candidate to delineate and suggest directions for future work in this topic.

The research work has been published in high impact-factor, peer reviewed Journals, presented at several international conferences, and the candidate was recipient of scientific awards and of the Swiss Government Excellence Scholarship, therefore supporting the interest of the international scientific community to this work.

Sincerely,

Francesca Soavi

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