جامعة عبد المالك السعدي
Université Abdelmalek Essaadi

Centre des Etudes Doctorales Sciences et Techniques
&
Sciences Médicales

THESIS DEFENSE

Mr. Youssef KHARCHOUF

CANDIDATE FOR DOCTOR SCIENCES AND TECHNIQUES

Title: Development of a Microfluidic Redox Flow Battery

Date :	**Saturday, December 16th, 2023**
Time :	**10.00 am**
Location :	**Conference Room, Building F, FST - Tangier**

Committe Members		
Pr. Mohamed ADDOU	FST- Tangier	Chair
Pr. Cristina IOJOIU	University of Grenoble	Reviewer
Pr. Soufian DERFOUFI	FST- Tangier	Reviewer
Pr. Amine MOUSSAOUI	FS - Oujda	Reviewer
Dr. Vincent VIVIER	University of Sorbonne	Examiner
Pr. Mireille TURMINE	University of Sorbonne	Co-Supervisor
Pr. Adil CHAHBOUN	FST- Tangier	Co-Supervisor
Pr. Mustapha DIANI	FST- Tangier	Supervisor

ABSTRACT

This work aims to advance the integration of microfluidic redox flow batteries and computational modeling to develop energy conversion technologies. A flow-through microfluidic cell is de veloped using porous electrodes for increased active surface area and reactant utilization. Due to their potential as electrolytes, the Emim[TFSI] ionic liquid is used in an Iron(II)/Quinone system due to the wide electrochemical window and its viscosity that ensures a colaminar flow within the channels of the device. This minimizes reactant crossover and leads to higher performance. The flow-through architecture used consists of forcing the elec trolytes to flow within the electrode pores before reaching the outlet. The cell is compared to a similar flow-by planar electrode cell and shows a significant increase in power output. Furthermore, a Lattice Boltzmann based model is developed to simulate fluid flow and mass transport within the cell. Elec trochemical reactions are modelled using Butler-Volmer kinetics and are coupled with mass transport through the source term of the convection-diffusion equation. The model is validated with flow and transport problems with well-known analytical solu tions. For the sake of including porous electrodes, a stochastic method for the generation of synthetic porous media for use with this model is also presented and the effects of the porosity on the current across a porous electrode is studied.