Universitat Politècnica de Catalunya

Master Thesis

State Observers Design for PEMFC Systems

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Dedicated to ...

Acknowledgements

Acknowledgements

Abstract

Abstract

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Abbreviations

AFC	**A**lkaline **F**uel **C**ell
BD	**B**ack **D**iffusion
CL	**C**atalyst **L**ayer
DC	**D**irect **C**urrent
CHP	**C**ombined **H**eat and **P**ower
DMFC	**D**irect **M**ethanol **F**uel **C**ell
EOD	**E**lectro-**O**smotic **D**rag
GDL	**G**as **D**iffusion **L**ayers
HHV	**H**igher **H**eating **V**alue
LHV	**L**ower **H**eating **V**alue
LMI	**L**inear **M**atrix **I**nequality
MCFC	**M**olten **C**arbonate **F**uel **C**ell
MEA	**M**embrane **E**lectrode **A**ssembly
MIMO	**M**ultiple-**I**nput and **M**ultiple-**O**utput
PAFC	**P**hosphoric **A**cid **F**uel **C**ell
PDE	**P**artial **D**ifferential **E**quation
PEM	**P**roton **E**xchange **M**embrane
PEMFC	**P**roton **E**xchange **M**embrane **F**uel **C**ell
SISO	**S**ingle-**I**nput and **S**ingle-**O**utput
SMC	**S**liding **M**ode **C**ontrol
SOFC	**S**olid **O**xide **F**uel **C**ell
STA	**S**uper-**T**wisting **A**lgorithm

Nomenclature

Roman letters

A	Electrode area	m^2
C	Volumetric capacitance	C V^{-1} m^{-3}
c	Concentration	mol m^{-3}
D	Diffusion coefficient	m^2 s^{-1}
$D_{i,k}^{eff}$	Diffusion coefficient	m^2 s^{-1}
D_W	Self-diffusion coefficient of water in the membrane	m^2 s^{-1}
E	Electrical potential	V
f^V	Surface enlargement factor	
h	Molar enthalpy	J mol^{-1}
I	Electrical current	A
i	Current density	A m^{-2}
i_0	Exchange current density	A m^{-2}
L	Length	m
$L_{x,y,z}$	Length through the x, y or z coordinates	m
M	Molar mass	g mol^{-1}
$\dot{n}$	Molar flux density	mol m^{-1} s^{-1}
n	Number of electrons per molecule of H_2	
n_{Vol}	Number of discretization volumes	
P	Electrical power	W
p	Pressure	Pa
q	Charge	Coulombs mol^{-1}
r	Reaction rate	mol m^{-2} s^{-1}
t	Time	s
t_W	Transport number of water in the membrane	

T	Temperature	K
U	Voltage	V
u	Specific internal energy	J kg^{-1}
v	Flow velocity	m s^{-1}
W_{el}	Electrical work	J mol^{-1}
x	Space coordinate	m
X	Ion exchange capacity	mol kg^{-1}
y	Space coordinate	m
z	Space coordinate	m

Greek letters

α	Heat transfer coefficient	W m^{-2} K^{-1}
δ	Thickness of layer in y-direction	m
κ	Electrical conductivity of the membrane	Ω^{-1} m^{-1}
λ	Heat conductivity	W K^{-1} m^{-2}
Λ	Water content	$\frac{N(H_2O}{N(\text{polymer})}$
μ	Electrochemical potential	J mol^{-1}
ξ	Mole fraction	
ρ	Density	kg m^{-3}
Φ	Electrical potential	V

Subscripts

i	Component mass index on anode and cathode sides
in	Input flux
j	n-th discretization volume
r	Chemical reaction term
ref	Reference value

Superscripts

A	Anode
amb	Ambient conditions
C	Cathode
dry	Dry conditions
k	Anode side ($k = A$) or cathode side ($k = C$)
M	Membrane
S	Solid

Physical Constants

Faraday constant	F	=	96485.3365 C mol^{-1}
Avogadro constant	N_A	=	6.0221×10^{23} molecules mol^{-1}
Charge of one e^-	q_{el}	=	1.602×10^{-19} C per e^-
Gas constant	R	=	8.314472 J mol^{-1} K^{-1}

Chapter 1

Chapter Title Here

1.1 Main Section 1

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1.2 Main Section 2

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