Chapter 2
Thermodynamics of Fuel Cells

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Nomenclature

\( \dot{m} \) \hspace{1em} mass flow
\( N_A \) \hspace{1em} Avogadro constant
\( \dot{n}^* \) \hspace{1em} constant molar flow at the fuel cells anode
\( n^{el} \) \hspace{1em} quantity of released electrons related on the utilised fuel
\( \dot{n}^{el} \) \hspace{1em} molar flow of electrons
\( n_F \) \hspace{1em} molar quantity of the supplied fuel
\( \dot{n} \) \hspace{1em} molar flow
\( n \) \hspace{1em} molar quantity
\( p \) \hspace{1em} total pressure
\( p_0 \) \hspace{1em} standard pressure
\( P_{el} \) \hspace{1em} electrical power
\( p_{el} \) specific electrical power
\( p_i \) partial pressure of the component \( i \)
\( P_{\text{loss}} \) power loss
\( P_{\text{rev}} \) reversible electrical power
\( Q \) heat
\( q \) specific heat
\( R \) electric or ohmic resistance
\( R_m \) universal gas constant
\( s^* \) specific entropy related to the standard state
\( S \) total entropy
\( \Delta r S \) reaction entropy
\( \Delta s \) entropy production
\( T \) absolute temperature
\( U_f \) fuel utilisation
\( V \) voltage or potential
\( E_N \) Nernst voltage
\( \delta V \) voltage loss
\( v \) specific volume
\( -W_t \) technical work
\( -w_t \) specific technical work
\( x \) molar concentration
\( \eta \) efficiency
\( \varphi \) celsius temperature
\( \lambda \) excess air value
\( \mu \) fuel related specific mass
\( v \) fuel related quantity
\( \zeta \) exergetic efficiency

Indices and abbreviations

0 stoichiometric value
A air
aB after burner outlet
AH air heater
AFC air at thermodynamic state of the fuel cell
An anode
ASR area specific resistance
Ca cathode
CC Carnot cycle
CHP combined heat and power generation
ECO economizer
EXCO external cooling
F fuel
FC fuel cell
FFC fuel at thermodynamic state of the fuel cell
FGC flue gas cooler
FH fuel heater
G flue gas