1 Variables

2 root

	var	symbol	documentation	type	units	eqs
10	$F_{N,A}$	`F`	basic directed graph incidence matrix	network		
97	I_A	`I_A`	vector of ones of length arcs	projection		
96	I_N	`I_N`	vector of ones of length nodes	projection		
48	$I_{N,A}$	`I_N_A`	project node on arc	projection		
4	t	`t`	time	frame	s	
5	t^o	`to`	time zero	frame	s	3
6	t^e	`te`	time end	frame	s	4
7	Δt	`t_interval`	time interval	frame	s	5
9	Δ	`pulse`	pulse of length time interval	frame		7
8	0.5	`onehalf`	numerical one half	constant		6
1	#	`value`	numerical value	constant		
3	0	`zero`	numerical value zero	constant		2
2	1	`one`	numerical one	constant		1

3 physical

	var	symbol	documentation	type	units	eqs
98	I_S	`I_S`	vector of ones of length sepecies	projection		
13	$r_{y\,N}$	`r_y`	y-direction	frame	m	9
11	ℓ_N	`l`	length	frame	m	
12	$r_{x\,N}$	`r_x`	x-direction	frame	m	8
14	$r_{z\,N}$	`r_z`	z-direction	frame	m	10
15	V_N	`V`	fundamental state - volume	state	m^3	11
23	A_N	`A`	Helmholts energy	state	$kg\,m^2\,s^{-2}$	17
17	S_N	`S`	fundamental state - entropy	state	$kg\,m^2\,K^{-1}\,s^{-2}$	
22	H_N	`H`	Enthalpy	state	$kg\,m^2\,s^{-2}$	15 128
18	$n_{N,S}$	`n`	fundamental state - molar mass	state	mol	129
24	G_N	`G`	Gibbs free energy	state	$kg\,m^2\,s^{-2}$	18
25	C_N	`C`	fundamental state - charge	state	$A\,s$	
16	U_N	`U`	fundamental state - internal energy	state	$kg\,m^2\,s^{-2}$	
32	A^v	`Av`	Avogadro number	constant	mol^{-1}	
34	R_N	`R`	Gas constant	constant	$kg\,m^2\,mol^{-1}\,K^{-1}\,s^{-2}$	25
33	B_N	`Boltz`	Boltzmann constant	constant	$kg\,m^2\,K^{-1}\,s^{-2}$	24
21	$\mu_{N,S}$	`chemPot`	chemical potential	effort	$kg\,m^2\,mol^{-1}\,s^{-2}$	14 88
19	T_N	`T`	temperature	effort	K	16
20	p_N	`p`	pressure	effort	$kg\,m^{-1}\,s^{-2}$	13
35	$U^e{}_N$	`Ue`	electrical potential – voltage	effort	$kg\,m^2\,A^{-1}s^{-3}$	26
29	$v_{z\,N}$	`v_z`	velocity in z-direction	secondaryState	ms^{-1}	21
27	$v_{x\,N}$	`v_x`	velocity in x-direction	secondaryState	ms^{-1}	19

Continued on next page

	var	symbol	documentation	type	units	eqs
28	${v_y}_N$	`v_y`	velocity in y-direction	secondaryState	ms^{-1}	20

4 reactions

	var	symbol	documentation	type	units	eqs
113	$P_{N,CS}$	P_N_K	what node has what reaction	projection		
114	$T_{N,CS}$	T_K	temparature of the nodes with reactions	effort	K	99
129	$\bar{n}_{N,S,CS}$	cn_NK	normed concentration – context node and conversion	secondaryState		113
128	$\bar{n}_{N,S}$	cn	normed concentration	secondaryState		112
115	$E_{a\,N,CS}$	Ea	Arrhenius activation energy	properties	$kg\,m^2\,mol^{-1}\,s^{-2}$	100
131	$\phi_{N,CS}$	interactionProbability	probability for the species to meet to undergo reaction	properties		115
118	$N_{S,CS}$	N	stoichiometric matrix	properties		
134	${K^o}_{CS}$	Ko	Arrhenius frequency factor – a strange construction	properties	$m^{-3}\,mol\,s^{-1}$	118
135	$K_{N,CS}$	K	reaction"constant	properties	$m^{-3}\,mol\,s^{-1}$	119
126	${c^n}_{N,S}$	c_norming	norming concentration used in the definition of the species interaction probability	properties	$m^{-3}\,mol$	110
136	$\tilde{n}_{N,S}$	nProd	production term for differential component mass balance	conversion	$mol\,s^{-1}$	120

5 material

	var	symbol	documentation	type	units	eqs
38	${k^q_x}_N$	kq_x	thermal conductivity in x-direction	property	$kg\,K^{-1}\,s^{-3}$	29
60	v_S	v	molar volume of species	property	$m^3\,mol^{-1}$	50
55	${k^q_x}_A$	kq_x_A	thermal conductivity in x-direction in arc	property	$kg\,K^{-1}\,s^{-3}$	45
40	${k^q_z}_N$	kq_z	thermal conductivity in z-direction	property	$kg\,K^{-1}\,s^{-3}$	31
62	${k^{d,Fick}_y}_{A,S}$	kd_y_Fick	Fick's diffusivity in arc and y-direction	property	ms^{-1}	52
36	${C_p}_N$	Cp	total heat capacity at constant pressure	property	$kg\,m^2\,K^{-1}\,s^{-2}$	27
56	${k^q_y}_A$	kq_y_A	thermal conductivity in y-direction in arc	property	$kg\,K^{-1}\,s^{-3}$	46
49	${k^c_x}_A$	kc_x_A	convective mass conductivity in x-direction in arc	property	$m^{-1}\,s$	39
58	m_N	m	mass	property	kg	48
107	$h_{A\,A,S}$	h_A	partial molar enthalpies of transport system	property	$kg\,m^2\,mol^{-1}\,s^{-2}$	93
54	${k^d_z}_{A,S}$	kd_z_A	diffusional mass conductivity in z-direction in arc	property	$kg^{-1}\,m^{-4}\,mol^2\,s$	44
51	${k^c_z}_A$	kc_z_A	convective mass conductivity in z-direction in arc	property	$m^{-1}\,s$	41
26	λ_S	Mm	species' molecular mass	property	$kg\,mol^{-1}$	
37	${C_v}_N$	Cv	total heat capacity at constant volume	property	$kg\,m^2\,K^{-1}\,s^{-2}$	28
63	${k^{d,Fick}_z}_{A,S}$	kd_z_Fick	Fick's diffusivity in arc and z-direction	property	ms^{-1}	53
47	$h_{N,S}$	h	partial molar enthalpies	property	$kg\,m^2\,mol^{-1}\,s^{-2}$	38
44	${k^c_x}_N$	kc_x	convective mass conductivity in x-direction	property	$m^{-1}\,s$	35
61	${k^{d,Fick}_x}_{A,S}$	kd_x_Fick	Fick's diffusivity in arc and x-direction	property	ms^{-1}	51
39	${k^q_y}_N$	kq_y	thermal conductivity in y-direction	property	$kg\,K^{-1}\,s^{-3}$	30
43	${k^d_z}_{N,S}$	kd_z	diffusional mass conductivity in z-direction	property	$kg^{-1}\,m^{-4}\,mol^2\,s$	34
42	${k^d_y}_{N,S}$	kd_y	diffusional mass conductivity in z-direction	property	$kg^{-1}\,m^{-4}\,mol^2\,s$	33
50	${k^c_y}_A$	kc_y_A	convective mass conductivity in y-direction in arc	property	$m^{-1}\,s$	40
46	${k^c_z}_N$	kc_z	convective mass conductivity in z-direction	property	$m^{-1}\,s$	37

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	var	symbol	documentation	type	units	eqs
45	${k^c_y}_N$	kc_y	convective mass conductivity in y-direction	property	$m^{-1}\,s$	36
89	ρ_A	density_A	density of arc material	property	$kg\,m^{-3}$	78
53	${k^d_y}_{A,S}$	kd_y_A	diffusional mass conductivity in y-direction in arc	property	$kg^{-1}\,m^{-4}\,mol^2\,s$	43
52	${k^d_x}_{A,S}$	kd_x_A	diffusional mass conductivity in x-direction in arc	property	$kg^{-1}\,m^{-4}\,mol^2\,s$	42
59	ρ_N	density	density	property	$kg\,m^{-3}$	49
57	${k^q_z}_A$	kq_z_A	thermal conductivity in z-direction in arc	property	$kg\,K^{-1}\,s^{-3}$	47
41	${k^d_x}_{N,S}$	kd_x	diffusional mass conductivity in x-direction	property	$kg^{-1}\,m^{-4}\,mol^2\,s$	32
102	${\mu^o}_{N,S}$	chemPot_o	standard chemical potential	effort	$kg\,m^2\,mol^{-1}\,s^{-2}$	86

6 macroscopic

	var	symbol	documentation	type	units	eqs
142	$\dot{w}_N$	aw	enthalpy accumulation due to work flows	transport	$kg\, m^2\, s^{-3}$	126
110	$\hat{H}^d{}_A$	fHd	enthalpy flow due to diffusive mass flow	transport	$kg\, m^2\, s^{-3}$	96
104	$\dot{n}^d{}_{N,S}$	and	accumulation due to diffusional mass transfer	transport	$mol\, s^{-1}$	90
91	$\dot{V}_A$	fV	volumetric flow	transport	$m^3\, s^{-1}$	80
111	$\dot{H}^c{}_N$	aHc	enthalpy accumulation due to convective mass flow	transport	$kg\, m^2\, s^{-3}$	97
101	$\hat{n}^d{}_{A,S}$	fnd	diffusional mass flow in arc	transport	$mol\, s^{-1}$	85 89
84	$\dot{q}_N$	aq	accumulation due to conductive heat flow	transport	$kg\, m^2\, s^{-3}$	73
92	$\hat{n}^c{}_{A,S}$	fnc	convective mass flow in an arc	transport	$mol\, s^{-1}$	81
87	$c_{A,S}$	c_A	concentration in convective mass flow	transport	$m^{-3}\, mol$	76
93	$\dot{n}^c{}_{N,S}$	anc	accumulation due to convective mass flow	transport	$mol\, s^{-1}$	82
112	$\dot{H}^d{}_N$	aHd	enthalpy accumulation due to diffusive mass flow	transport	$kg\, m^2\, s^{-3}$	98
83	$\hat{q}_{x\,A}$	fq_x	heat flow in arc and x-direction	transport	$kg\, m^2\, s^{-3}$	72
86	d_A	d	fow direction of convective flow	transport		75
141	$\hat{w}_A$	fw	just an numerical work flow term – as a starter	transport	$kg\, m^2\, s^{-3}$	125
109	$\hat{H}^c{}_A$	fHc	enthalpy flow due to convective mass flow	transport	$kg\, m^2\, s^{-3}$	95
65	$A_{xy\,N}$	A_xy	cross sectional area xy	geometry	m^2	54
66	$A_{xz\,N}$	A_xz	cross sectional area xz	geometry	m^2	55
70	$A_{yz\,A}$	A_yz_A	cross sectional area yz of arc	geometry	m^2	59
68	$A_{xy\,A}$	A_xy_A	cross sectional area yz of arc	geometry	m^2	57
69	$A_{xz\,A}$	A_xz_A	cross sectional area xz of arc	geometry	m^2	58
67	$A_{yz\,N}$	A_yz	cross sectional area yz	geometry	m^2	56
64	$D_{N,A}$	D	difference operator	differenceOperator		
145	$n^o{}_{N,S}$	no	initial species masses	state	mol	131

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	var	symbol	documentation	type	units	eqs
144	${H^o}_N$	`Ho`	initial enthalpy	state	$kg\, m^2\, s^{-2}$	130
100	$x_{N,S}$	`x`	concentration mole fraction	secondaryState		84
99	${n^t}_N$	`nt`	total amount	secondaryState	mol	83
85	$c_{N,S}$	`c`	molar concentration	secondaryState	$m^{-3}\, mol$	74
138	$\dot{n}_{N,S}$	`anProduction`	production term	conversion	$mol\, s^{-1}$	122
143	$\dot{H}_N$	`aH`	differential enthalpy balance	diffState	$kg\, m^2\, s^{-3}$	127
139	$\dot{n}_{N,S}$	`an`	differentional species balance	diffState	$mol\, s^{-1}$	123

7 macroscopic–reactions

	var	symbol	documentation	type	units	eqs
125	$\_c_{N,S}$	`_c`	link variable c to interface macroscopic »> reactions	get	$m^{-3}\,mol$	109

8 material–macroscopic

	var	symbol	documentation	type	units	eqs
77	$\_k^d_{y\,A,S}$	`_kd_y_A`	link variable kd y A to interface material »> macroscopic	get	$kg^{-1}\,m^{-4}\,mol^2\,s$	66
88	$\_\rho_N$	`_density`	link variable density to interface material »> macroscopic	get	$kg\,m^{-3}$	77
75	$\_k^{d,Fick}_{x\,A,S}$	`_kd_x_Fick`	link variable kd x Fick to interface material »> macroscopic	get	ms^{-1}	64
71	$\_k^c_{x\,A}$	`_kc_x_A`	link variable kc x A to interface material »> macroscopic	get	$m^{-1}\,s$	60
74	$\_k^d_{x\,A,S}$	`_kd_x_A`	link variable kd x A to interface material »> macroscopic	get	$kg^{-1}\,m^{-4}\,mol^2\,s$	63
90	$\_\rho_A$	`_density_A`	link variable density A to interface material »> macroscopic	get	$kg\,m^{-3}$	79
108	$\_h_{A,S}$	`_h_A`	link variable h A to interface material »> macroscopic	get	$kg\,m^2\,mol^{-1}\,s^{-2}$	94
76	$\_k^{d,Fick}_{y\,A,S}$	`_kd_y_Fick`	link variable kd y Fick to interface material »> macroscopic	get	ms^{-1}	65
30	$\_\lambda_S$	`_Mm`	link variable Mm to interface material »> macroscopic	get	$kg\,mol^{-1}$	22
80	$\_k^q_{x\,A}$	`_kq_x_A`	link variable kq x A to interface material »> macroscopic	get	$kg\,K^{-1}\,s^{-3}$	69
106	$\_h_{N,S}$	`_h`	link variable h to interface material »> macroscopic	get	$kg\,m^2\,mol^{-1}\,s^{-2}$	92
73	$\_k^c_{z\,A}$	`_kc_z_A`	link variable kc z A to interface material »> macroscopic	get	$m^{-1}\,s$	62
82	$\_k^q_{z\,A}$	`_kq_z_A`	link variable kq z A to interface material »> macroscopic	get	$kg\,K^{-1}\,s^{-3}$	71
81	$\_k^q_{y\,A}$	`_kq_y_A`	link variable kq y A to interface material »> macroscopic	get	$kg\,K^{-1}\,s^{-3}$	70

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	var	symbol	documentation	type	units	eqs
72	$\_k^c_{y}{}_{A}$	`_kc_y_A`	link variable kc y A to interface material »> macroscopic	get	$m^{-1}\,s$	61
78	$\_k^d_{z}{}_{A,S}$	`_kd_z_A`	link variable kd z A to interface material »> macroscopic	get	$kg^{-1}\,m^{-4}\,mol^2\,s$	67
79	$\_k^{d,Fick}_{z}{}_{A,S}$	`_kd_z_Fick`	link variable kd z Fick to interface material »> macroscopic	get	ms^{-1}	68

9 reactions–macroscopic

	var	symbol	documentation	type	units	eqs
119	$\_{E^a}_{N,CS}$	`_Ea`	link variable Ea to interface reactions »> macroscopic	get	$kg\,m^2\,mol^{-1}\,s^{-2}$	103
137	$\_\tilde{n}_{N,S}$	`_nProd`	link variable nProd to interface reactions »> macroscopic	get	$mol\,s^{-1}$	121
122	$_{N\,S,CS}$	`_N`	link variable N to interface reactions »> macroscopic	get		106
123	$\_T_{N,CS}$	`_T_K`	link variable T K to interface reactions »> macroscopic	get	K	107

10 macroscopic–material

	var	symbol	documentation	type	units	eqs
103	$\_x_{N,S}$	`_x`	link variable x to interface macroscopic »> material	get		87

11 Equations

12 Generic

no	equation	documentation	layer
1	$1 := \mathrm{Instantiate}(\#, \#)$	numerical one	root
2	$0 := \mathrm{Instantiate}(\#, \#)$	numerical value zero	root
3	$t^o := \mathrm{Instantiate}(t, 0)$	time zero	root
4	$t^e := \mathrm{Instantiate}(t, \#)$	time end	root
5	$\Delta t := \mathrm{Instantiate}(t, \#)$	time interval	root
6	$0.5 := \mathrm{Instantiate}(\#, \#)$	numerical one half	root
7	$\Delta := \mathrm{sign}\,(t - t^o) - \mathrm{sign}\,(t - (t^o - \Delta t))$	pulse of length time interval	root
8	$r_{x\,N} := \mathrm{Instantiate}(\ell_N, \#)$	x-direction	physical
9	$r_{y\,N} := \mathrm{Instantiate}(\ell_N, \#)$	y-direction	physical
10	$r_{z\,N} := \mathrm{Instantiate}(\ell_N, \#)$	z-direction	physical
11	$V_N := r_{x\,N} \,.\, r_{y\,N} \,.\, r_{z\,N}$	volume	physical
13	$p_N := \frac{\partial U_N}{\partial V_N}$	pressure	physical
14	$\mu_{N,S} := \frac{\partial U_N}{\partial n_{N,S}}$	chemical potential	physical
15	$H_N := U_N - p_N \,.\, V_N$	Enthalpy	physical
16	$T_N := \frac{\partial U_N}{\partial S_N}$	temperature	physical
17	$A_N := U_N - T_N \,.\, S_N$	Helmholts energy	physical

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no	equation	documentation	layer
18	$G_N := U_N + p_N \,.\, V_N - T_N \,.\, S_N$	Gibbs free energy	physical
19	$v_{x\,N} := (t)^{-1} \,.\, r_{x\,N}$	velocity in x-direction	physical
20	$v_{y\,N} := (t)^{-1} \,.\, r_{y\,N}$	velocity in y-direction	physical
21	$v_{z\,N} := (t)^{-1} \,.\, r_{z\,N}$	velocity in z-direction	physical
24	$B_N := \mathrm{Instantiate}(S_N, \#)$	Boltzmann constant	physical
25	$R_N := A^v \,.\, B_N$	Gas constant	physical
26	${U^e}_N := (C_N)^{-1} \,.\, U_N$	electrical potential – voltage	physical
27	$C_{p\,N} := \frac{\partial H_N}{\partial T_N}$	total heat capacity at constant pressure	material
28	$C_{v\,N} := \frac{\partial U_N}{\partial T_N}$	total heat capacity at constant volume	material
29	$k^q_{x\,N} := (V_N)^{-1} \,.\, C_{p\,N} \,.\, v_{x\,N}$	thermal conductivity in x-direction	material
30	$k^q_{y\,N} := (V_N)^{-1} \,.\, C_{p\,N} \,.\, v_{y\,N}$	thermal conductivity in y-direction	material
31	$k^q_{z\,N} := (V_N)^{-1} \,.\, C_{p\,N} \,.\, v_{z\,N}$	thermal conductivity in z-direction	material
32	$k^d_{x\,N,S} := (\mu_{N,S})^{-1} \,.\, \left(v_{x\,N} \,.\, \left((V_N)^{-1} \,.\, \frac{\partial U_N}{\partial \mu_{N,S}}\right)\right)$	diffusional mass conductivity in x-direction	material
33	$k^d_{y\,N,S} := (\mu_{N,S})^{-1} \,.\, \left(v_{y\,N} \,.\, \left((V_N)^{-1} \,.\, \frac{\partial U_N}{\partial \mu_{N,S}}\right)\right)$	diffusional mass conductivity in y-direction	material
34	$k^d_{z\,N,S} := (\mu_{N,S})^{-1} \,.\, \left(v_{z\,N} \,.\, \left((V_N)^{-1} \,.\, \frac{\partial U_N}{\partial \mu_{N,S}}\right)\right)$	diffusional mass conductivity in z-direction	material
35	$k^c_{x\,N} := \left(\lambda_S \star (\mu_{N,S})^{-1}\right) \,.\, (V_N)^{-1} \,.\, \frac{\partial U_N}{\partial p_N} \,.\, v_{x\,N}$	convective mass conductivity in x-direction	material

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no	equation	documentation	layer
36	$k^c_{yN} := \left(\lambda_S \star (\mu_{N,S})^{-1}\right) . (V_N)^{-1} . \frac{\partial U_N}{\partial p_N} . v_{yN}$	convective mass conductivity in y-direction	material
37	$k^c_{zN} := \left(\lambda_S \star (\mu_{N,S})^{-1}\right) . (V_N)^{-1} . \frac{\partial U_N}{\partial p_N} . v_{zN}$	convective mass conductivity in z-direction	material
38	$h_{N,S} := H_N . (n_{N,S})^{-1}$	partial molar enthalpies	material
39	$k^c_{xA} := I_{N,A} \star k^c_{xN}$	convective mass conductivity in x-direction in arc	material
40	$k^c_{yA} := I_{N,A} \star k^c_{yN}$	convective mass conductivity in y-direction in arc	material
41	$k^c_{zA} := I_{N,A} \star k^c_{zN}$	convective mass conductivity in z-direction in arc	material
42	$k^d_{xA,S} := I_{N,A} \star k^d_{xN,S}$	diffusional mass conductivity in x-direction in arc	material
43	$k^d_{yA,S} := I_{N,A} \star k^d_{yN,S}$	diffusional mass conductivity in z-direction in arc	material
44	$k^d_{zA,S} := I_{N,A} \star k^d_{zN,S}$	diffusional mass conductivity in z-direction in arc	material
45	$k^q_{xA} := I_{N,A} \star k^q_{xN}$	thermal conductivity in x-direction in arc	material
46	$k^q_{yA} := I_{N,A} \star k^q_{yN}$	thermal conductivity in y-direction in arc	material
47	$k^q_{zA} := I_{N,A} \star k^q_{zN}$	thermal conductivity in z-direction in arc	material
48	$m_N := \lambda_S \star n_{N,S}$	mass	material

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no	equation	documentation	layer
49	$\rho_N := (V_N)^{-1} \, . \, m_N$	density	material
50	$v_S := V_N \star (n_{N,S})^{-1}$	molar volume of species	material
51	$k_x^{d,Fick}{}_{A,S} := I_{N,A} \star \left(v_{x\,N} \cdot \frac{\partial U_N}{\partial \mu_{N,S}} \cdot (n_{N,S})^{-1} \right)$	Fick's diffusivity in arc and x-direction	material
52	$k_y^{d,Fick}{}_{A,S} := I_{N,A} \star \left(v_{y\,N} \cdot \frac{\partial U_N}{\partial \mu_{N,S}} \cdot (n_{N,S})^{-1} \right)$	Fick's diffusivity in arc and y-direction	material
53	$k_z^{d,Fick}{}_{A,S} := I_{N,A} \star \left(v_{z\,N} \cdot \frac{\partial U_N}{\partial \mu_{N,S}} \cdot (n_{N,S})^{-1} \right)$	Fick's diffusivity in arc and z-direction	material
54	$A_{xy\,N} := r_{x\,N} \, . \, r_{y\,N}$	cross sectional area xy	macroscopic
55	$A_{xz\,N} := r_{x\,N} \, . \, r_{z\,N}$	cross sectional area xz	macroscopic
56	$A_{yz\,N} := r_{y\,N} \, . \, r_{z\,N}$	cross sectional area yz	macroscopic
57	$A_{xy\,A} := I_{N,A} \star A_{xy\,N}$	cross sectional area yz of arc	macroscopic
58	$A_{xz\,A} := I_{N,A} \star A_{xz\,N}$	cross sectional area xz of arc	macroscopic
59	$A_{yz\,A} := I_{N,A} \star A_{yz\,N}$	cross sectional area yz of arc	macroscopic
72	$\hat{q}_{x\,A} := A_{yz\,A} \, . \, \_k^q_{x\,A} \, . \, (D_{N,A} \star T_N)$	heat flow in arc and x-direction	macroscopic
73	$\dot{q}_N := F_{N,A} \star \hat{q}_{x\,A}$	accumulation due to conductive heat flow	macroscopic
74	$c_{N,S} := (V_N)^{-1} \, . \, n_{N,S}$	molar concentration	macroscopic
75	$d_A := \text{sign} (D_{N,A} \star p_N)$	fow direction of convective flow	macroscopic
76	$c_{A,S} := (0.5 \, . \, (D_{N,A} - d_A \, . \, \lvert D_{N,A} \rvert)) \star c_{N,S}$	concentration in convective mass flow	macroscopic
78	$\rho_A := I_{N,A} \star \rho_N$	density of arc material	material
80	$\dot{V}_A := (\_\rho_A)^{-1} \, . \, \_k^c_{x\,A} \, . \, A_{yz\,A} \, . \, (D_{N,A} \star p_N)$	volumetric flow	macroscopic

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no	equation	documentation	layer
81	$\hat{n}^c{}_{A,S} := \dot{V}_A \,.\, c_{A,S}$	convective mass flow in an arc	macroscopic
82	$\dot{n}^c{}_{N,S} := F_{N,A} \star \hat{n}^c{}_{A,S}$	accumulation due to convective mass flow	macroscopic
83	$n^t{}_N := I_S \star n_{N,S}$	total amount	macroscopic
84	$x_{N,S} := \left(n^t{}_N\right)^{-1} \,.\, n_{N,S}$	concentration mole fraction	macroscopic
85	$\hat{n}^d{}_{A,S} := A_{yz\,A} \,.\, \left(-\_k_x^{d,Fick}{}_{A,S}\right) \,.\, \left(D_{N,A} \star c_{N,S}\right)$	diffusional mass flow in arc	macroscopic
86	$\mu^o{}_{N,S} := \text{Instantiate}(\mu_{N,S}, \#)$	standard chemical potential	material
88	$\mu_{N,S} := \mu^o{}_{N,S} + R_N \,.\, T_N \,.\, ln(\_x_{N,S})$	chemical potential standard model with mole fraction	material
89	$\hat{n}^d{}_{A,S} := A_{yz\,A} \,.\, \left(-\_k_x^d{}_{A,S}\right) \,.\, \left(D_{N,A} \star \mu_{N,S}\right)$	diffusional mass flow in arc	macroscopic
90	$\dot{n}^d{}_{N,S} := F_{N,A} \star \hat{n}^d{}_{A,S}$	accumulation due to diffusional mass transfer	macroscopic
93	$h_{A\,A,S} := I_{N,A} \star h_{N,S}$	partial molar enthalpies of transport system	material
95	$\hat{H}^c{}_A := I_S \star \left(\_h_{A,S} \,.\, \hat{n}^c{}_{A,S}\right)$	enthalpy flow due to convective mass flow	macroscopic
96	$\hat{H}^d{}_A := I_S \star \left(\_h_{A,S} \,.\, \hat{n}^d{}_{A,S}\right)$	enthalpy flow due to diffusive mass flow	macroscopic
97	$\dot{H}^c{}_N := F_{N,A} \star \hat{H}^c{}_A$	enthalpy accumulation due to convective mass flow	macroscopic
98	$\dot{H}^d{}_N := F_{N,A} \star \hat{H}^d{}_A$	enthalpy accumulation due to diffusive mass flow	macroscopic
99	$T_{N,CS} := T_N \,.\, P_{N,CS}$	temparature of the nodes with reactions	reactions

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no	equation	documentation	layer
100	$E_{a\,N,CS} := \text{Instantiate}(R_N \,.\, T_{N,CS}, \#)$	Arrhenius activation energy	reactions
110	$c^n{}_{N,S} := \text{Instantiate}(\_c_{N,S}, \#)$	norming concentration used in the definition of the species interaction probability	reactions
112	$\bar{n}_{N,S} := (c^n{}_{N,S})^{-1} \,.\, \_c_{N,S}$	normed concentration	reactions
113	$\bar{n}_{N,S,CS} := P_{N,CS} \,.\, \bar{n}_{N,S}$	normed concentration – context node and conversion	reactions
115	$\phi_{N,CS} := \prod_S \bar{n}_{N,S,CS}$	probability for the species to meet to undergo reaction	reactions
118	$K^o{}_{CS} := \text{Instantiate}(I_S \star \left(P_{N,CS} \star \left((t)^{-1} \,.\, (V_N)^{-1} \,.\, n_{N,S}\right)\right), \#)$	Arrhenius frequency factor – a strange construction	reactions
119	$K_{N,CS} := K^o{}_{CS} \,.\, exp((-E_{a\,N,CS}) \,.\, (R_N \,.\, T_{N,CS})^{-1})$	reaction"constant	reactions
120	$\tilde{n}_{N,S} := V_N \,.\, (N_{S,CS} \star (K_{N,CS} \,.\, \phi_{N,CS}))$	production term for differential component mass balance	reactions
122	$\dot{n}_{N,S} := \_\tilde{n}_{N,S}$	production term	macroscopic
123	$\dot{n}_{N,S} := \dot{n}^c{}_{N,S} + \dot{n}^d{}_{N,S} + \dot{n}_{N,S}$	differentional species balance	macroscopic
125	$\hat{w}_A := \text{Instantiate}(\hat{H}^c{}_A, \#)$	just an numerical work flow term – as a starter	macroscopic
126	$\dot{w}_N := F_{N,A} \star \hat{w}_A$	enthalpy accumulation due to work flows	macroscopic
127	$\dot{H}_N := \dot{H}^c{}_N + \dot{H}^d{}_N + \dot{q}_N + \dot{w}_N$	differential enthalpy balance	macroscopic
128	$H_N := \int_{t^o}^{t^e} \dot{H}_N \;\; dt + H^o{}_N$	Enthalpy	macroscopic

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no	equation	documentation	layer
129	$n_{N,S} := \int_{t^o}^{t^e} \; \dot{n}_{N,S} \;\; d\,t + n^o{}_{N,S}$	fundamental state - molar mass	macroscopic
130	$H^o{}_N := \text{Instantiate}(H_N, \#)$	initial enthalpy	macroscopic
131	$n^o{}_{N,S} := \text{Instantiate}(n_{N,S}, \#)$	initial species masses	macroscopic

13 Interface Link Equation

no	equation	documentation	layer
22	$\_\lambda_S := \lambda_S$	interface equation	material –> macroscopic
60	$\_k^c_x{}_A := k^c_x{}_A$	interface equation	material –> macroscopic
61	$\_k^c_y{}_A := k^c_y{}_A$	interface equation	material –> macroscopic
62	$\_k^c_z{}_A := k^c_z{}_A$	interface equation	material –> macroscopic
63	$\_k^d_x{}_{A,S} := k^d_x{}_{A,S}$	interface equation	material –> macroscopic
64	$\_k_x^{d,Fick}{}_{A,S} := k_x^{d,Fick}{}_{A,S}$	interface equation	material –> macroscopic
65	$\_k_y^{d,Fick}{}_{A,S} := k_y^{d,Fick}{}_{A,S}$	interface equation	material –> macroscopic
66	$\_k^d_y{}_{A,S} := k^d_y{}_{A,S}$	interface equation	material –> macroscopic
67	$\_k^d_z{}_{A,S} := k^d_z{}_{A,S}$	interface equation	material –> macroscopic
68	$\_k_z^{d,Fick}{}_{A,S} := k_z^{d,Fick}{}_{A,S}$	interface equation	material –> macroscopic
69	$\_k^q_x{}_A := k^q_x{}_A$	interface equation	material –> macroscopic

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no	equation	documentation	layer
70	$\_k^q_y{}_A := k^q_y{}_A$	interface equation	material –> macroscopic
71	$\_k^q_z{}_A := k^q_z{}_A$	interface equation	material –> macroscopic
77	$\_\rho_N := \rho_N$	interface equation	material –> macroscopic
79	$\_\rho_A := \rho_A$	interface equation	material –> macroscopic
87	$\_x_{N,S} := x_{N,S}$	interface equation	macroscopic –> material
92	$\_h_{N,S} := h_{N,S}$	interface equation	material –> macroscopic
94	$\_h_{A,S} := h_{A\,A,S}$	interface equation	material –> macroscopic
103	$\_E^a{}_{N,CS} := E_{a\,N,CS}$	interface equation	reactions –> macroscopic
106	${}_{N\,S,CS} := N_{S,CS}$	interface equation	reactions –> macroscopic
107	$\_T_{N,CS} := T_{N,CS}$	interface equation	reactions –> macroscopic
109	$\_c_{N,S} := c_{N,S}$	interface equation	macroscopic –> reactions
121	$\_\tilde{n}_{N,S} := \tilde{n}_{N,S}$	interface equation	reactions –> macroscopic