

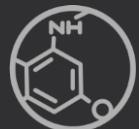


ADVANCED PROCESS MODELLING FORUM

22-23 APRIL 2015

Fuel Cell commercial system design

Zbigniew Urban – VP Fuel Cells & Batteries BU



Dreams come true (but only after years of hard work)



Toyota Mirai



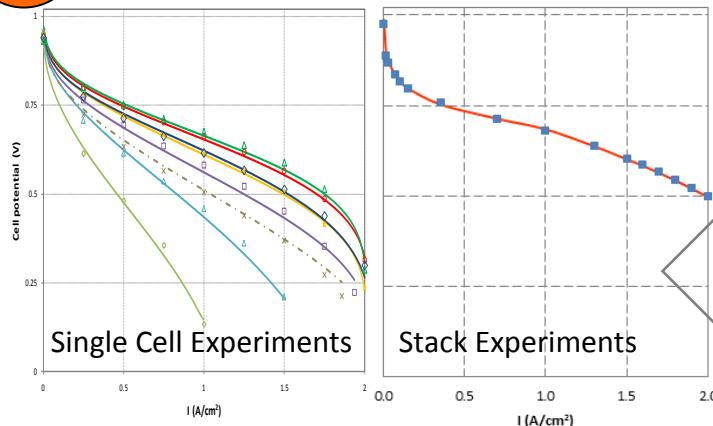
- PSE has been a sole provider of software and technology for mathematical modelling, dynamic simulation, data processing and design optimisation of Fuel Cell stacks and FC power plant systems to Toyota Motor Corporation and Honda for the last 5 years
- At present, PSE is actively involved in supporting HONDA in development of their commercial FC system for automotive applications

gPROMS for Fuel Cells stacks and power plant systems

Life cycle of stack and system design

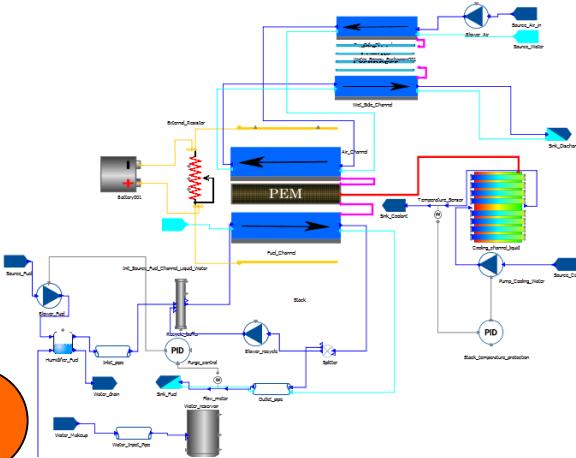
1

Data based validation of MEA



2

Stack performance in a simple system, water management, deactivation, design decisions

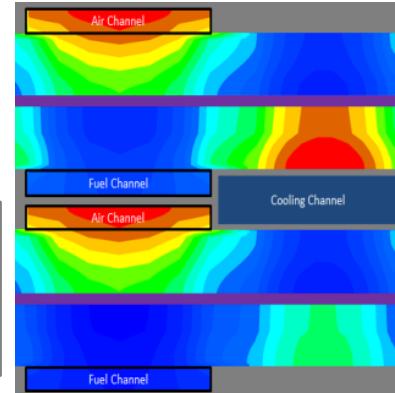


Data

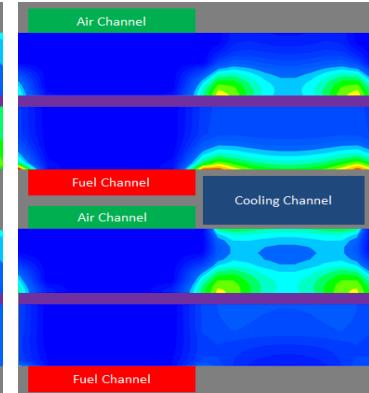
Processing

Detailed stack design

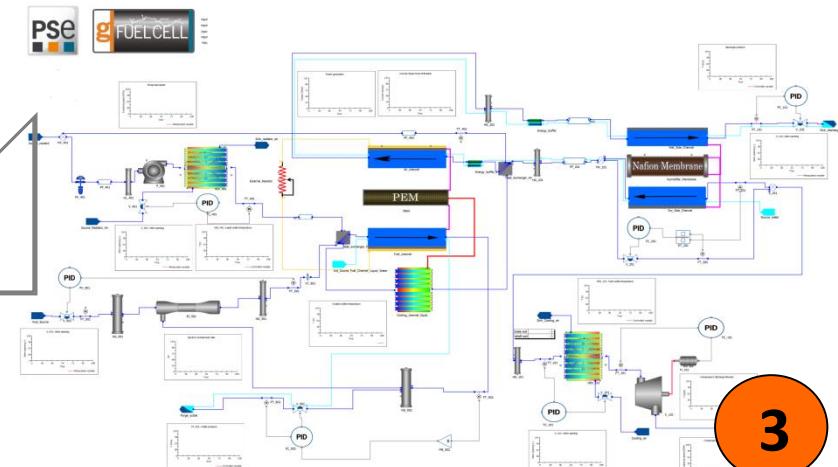
H_2, O_2 concentration



Water condensation



4

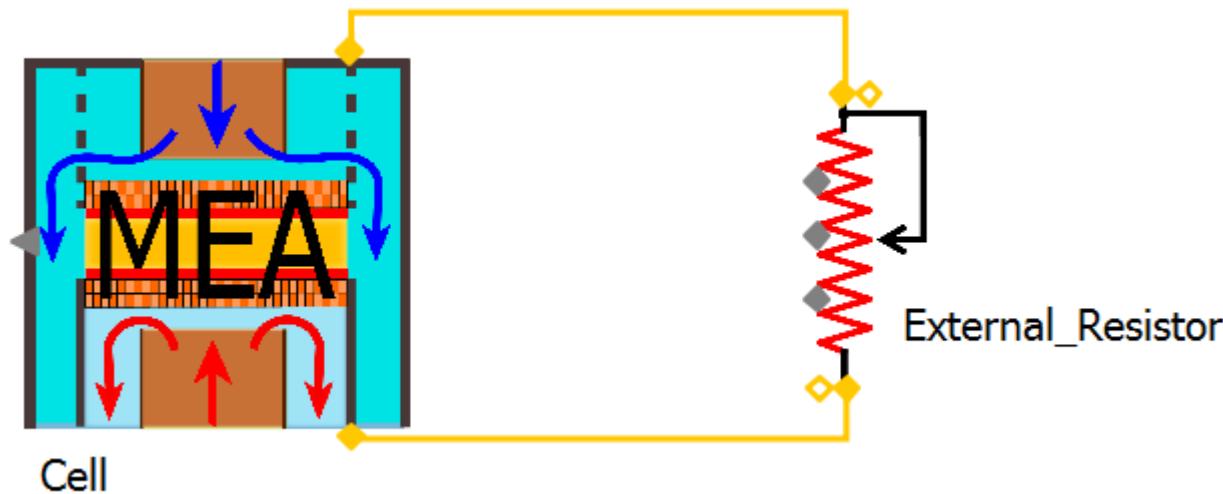


Design and optimisation of complete system for commercial applications, dynamic simulation of drive cycles



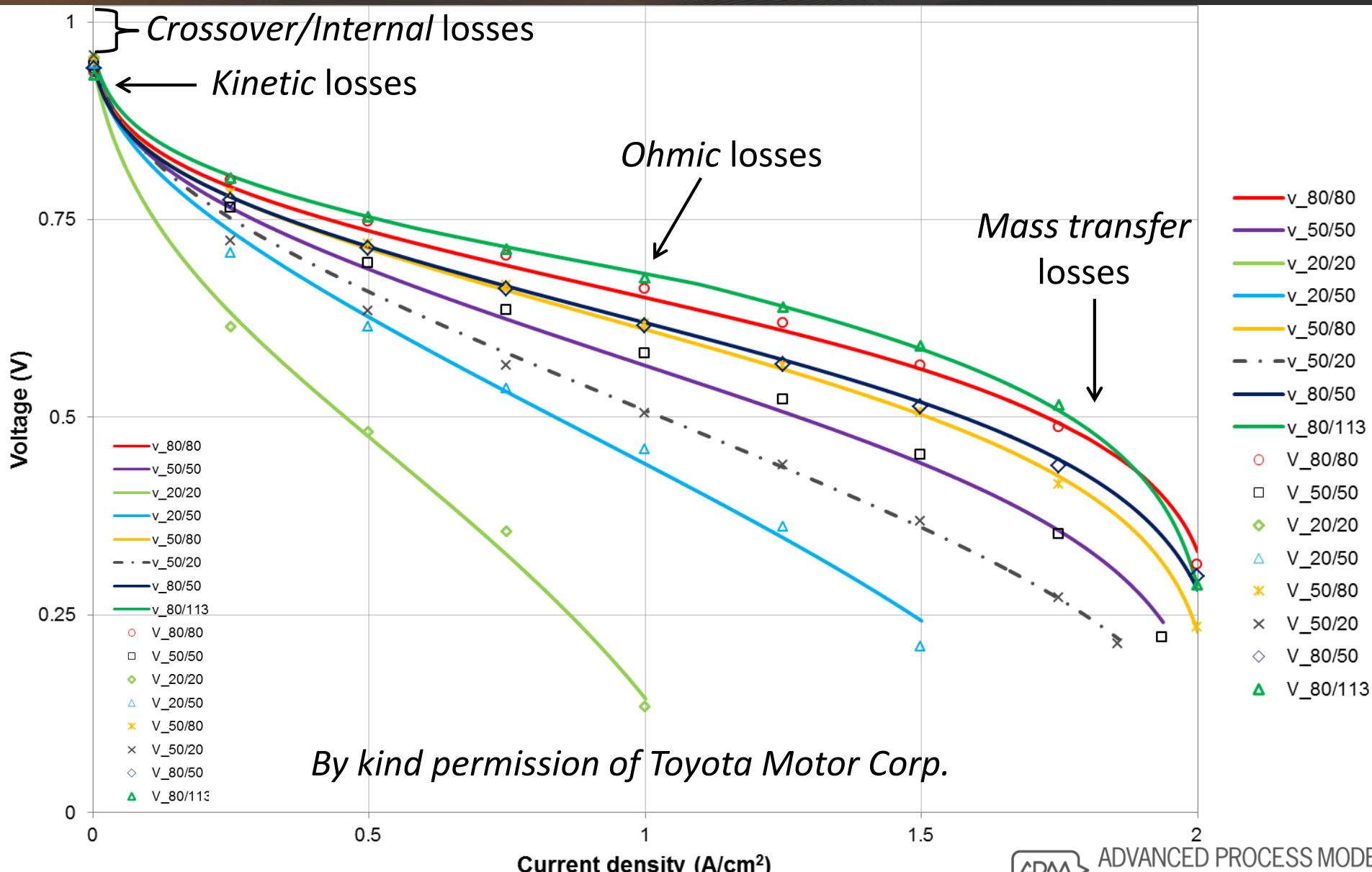
Making the most of experimental data

Data based validation of MEA

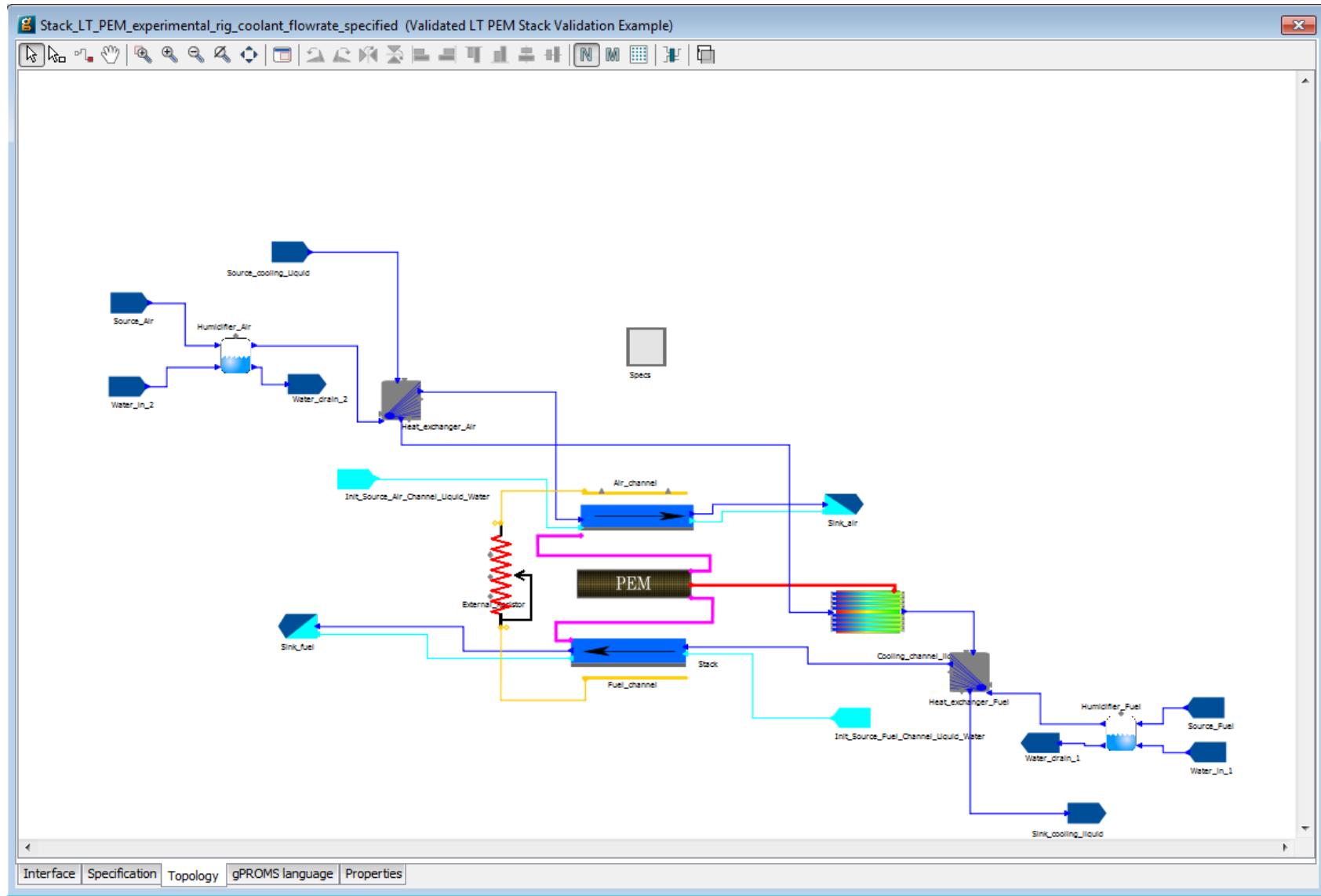


- Single coin-sized cell (4 cm^2)
- Operating at overflow conditions at anode and cathode
- Experiments
 - Vary current over time
 - Keep all other operating conditions constant
- Generate polarisation curves

Real data example of validated MEA



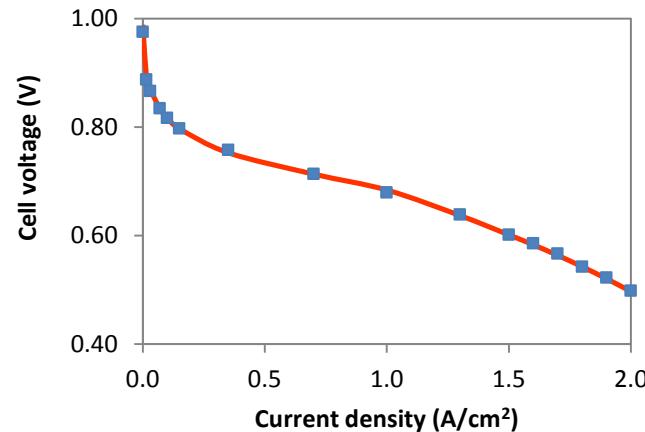
Setup for fuel cell stack pilot scale experiments



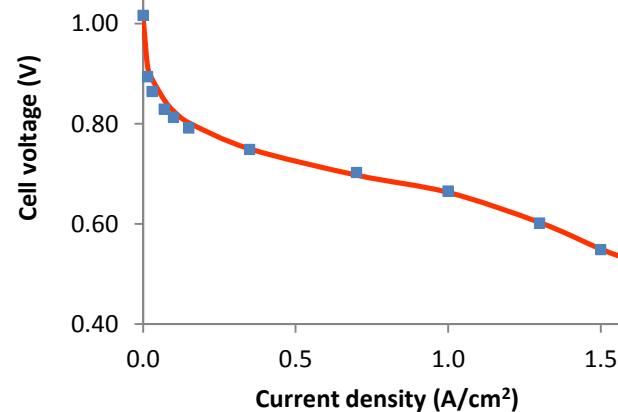
Fuel cell stack data processing

Data compiled from various sources in open literature

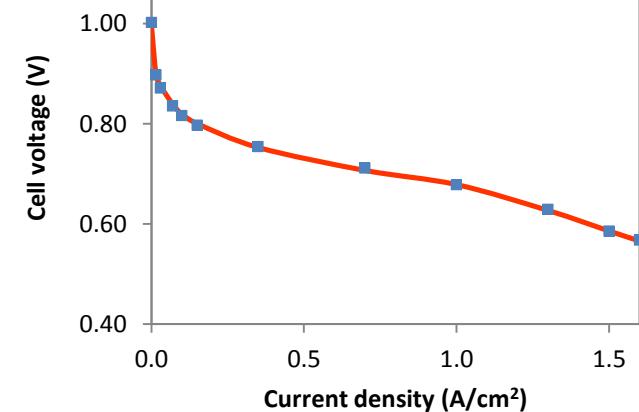
Reference



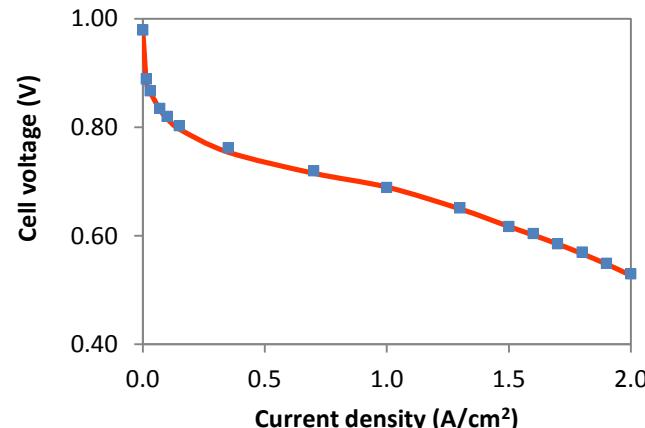
Ca_Xw_Low



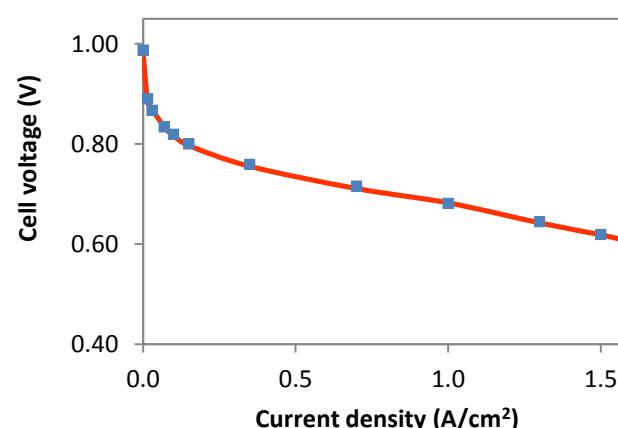
Ca_Xw_Medium



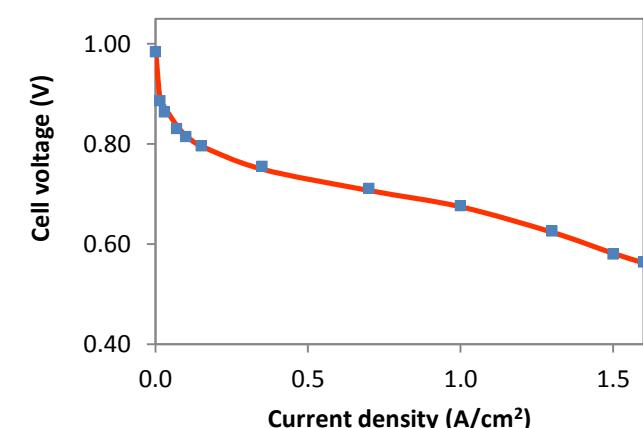
Ca_Xw_High



Cold_Coolant



Hot_Coolant

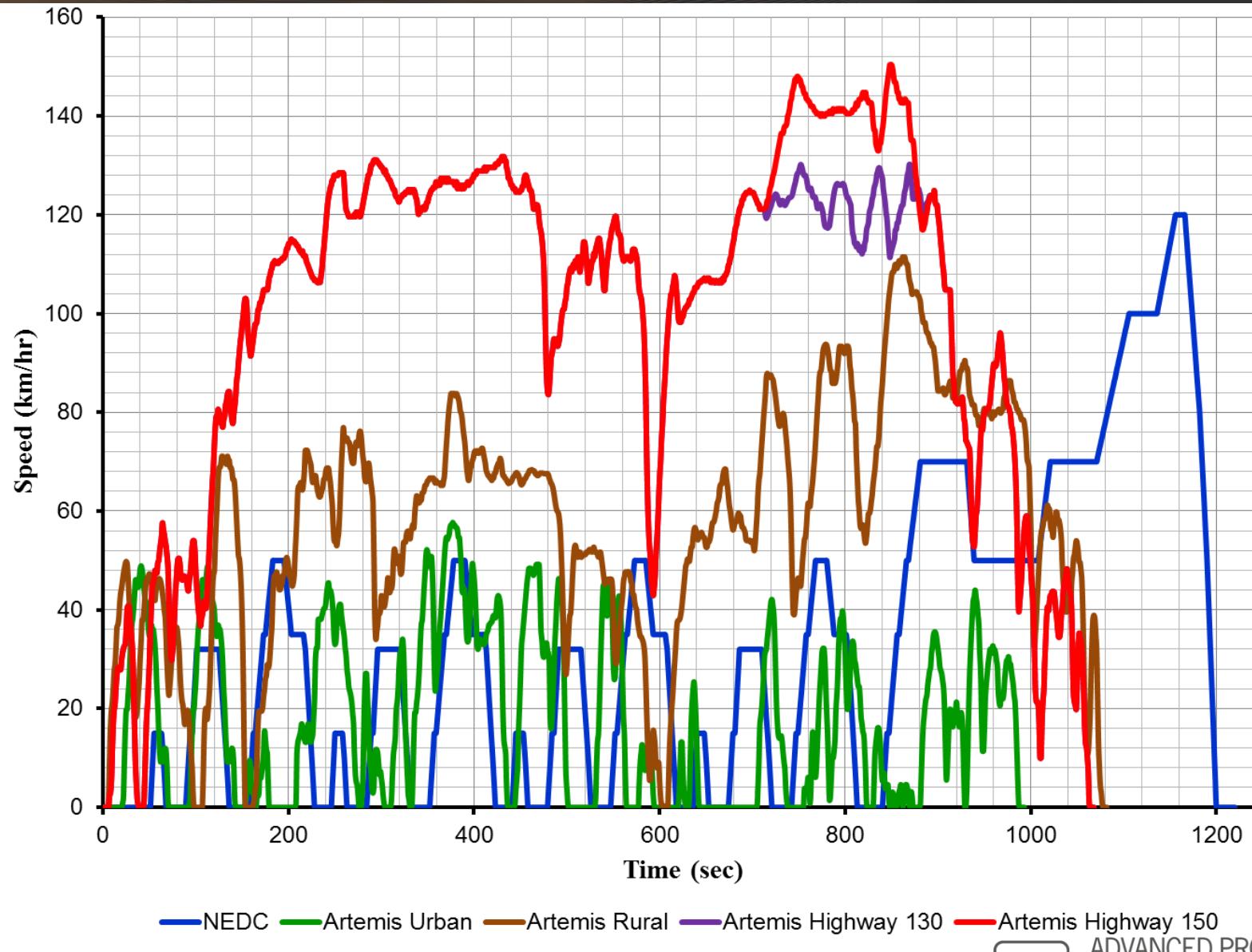


From stand-alone stack information to fully integrated systems

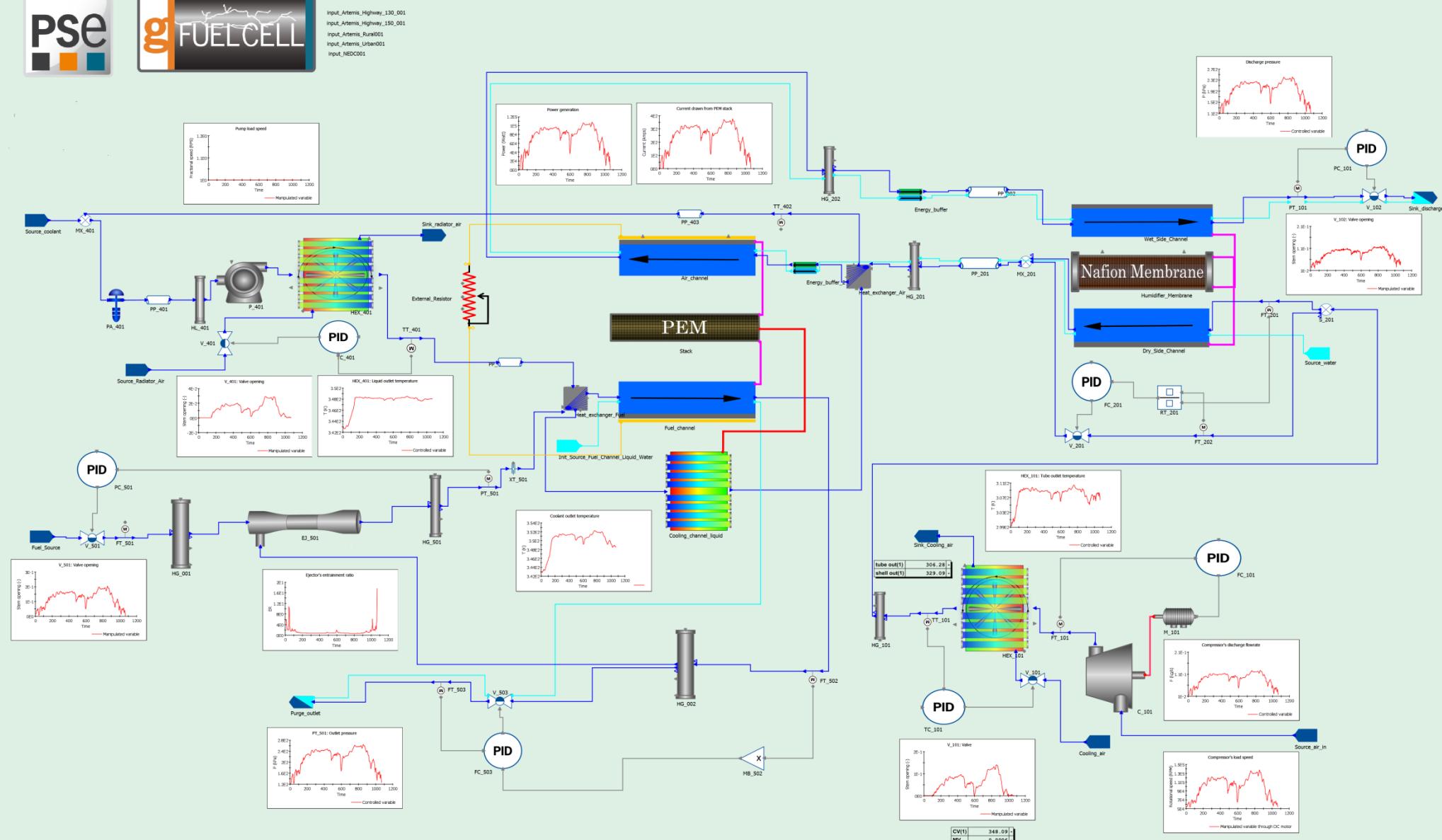
Successful commercialization of fuel cell technologies depends largely on how the fuel cell stack is integrated within the entire power plant system.

- Fully pressure driven models
- Include computation intensive, complex models
(e.g. PEM stack, humidifier)
- Robust in simulating extremely dynamic operations
- Accommodate hierarchical control structures
- Predictive to high degree to reproduce the pilot plant information

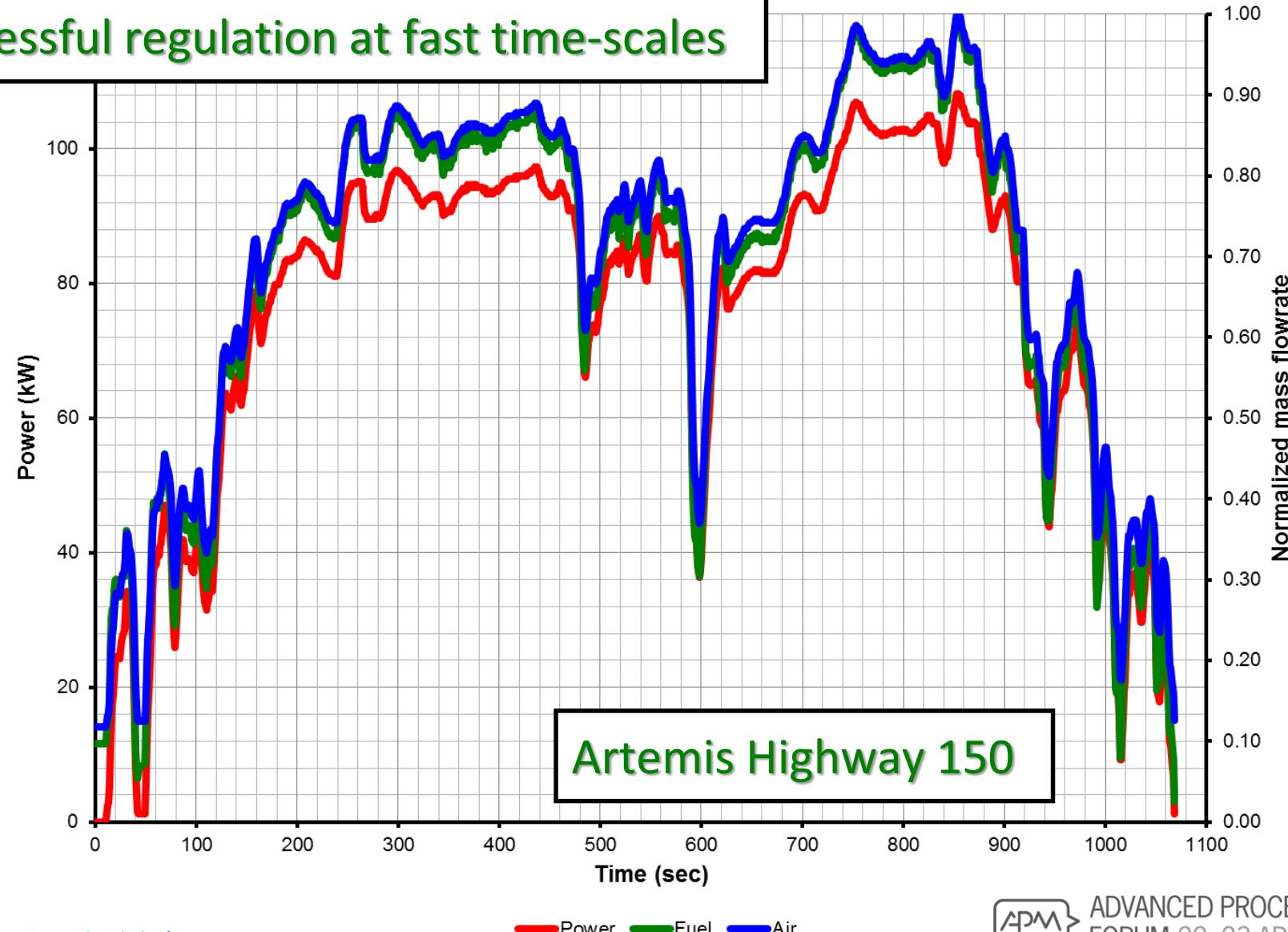
Performance assessment based on industry standard driving cycles



High level output from simulation of Artemis Highway 150



Successful regulation at fast time-scales





gPROMS enters the realm of CFD resolution
modelling

Geometry of the cross section of a standard cell in stack

422

F. Blank

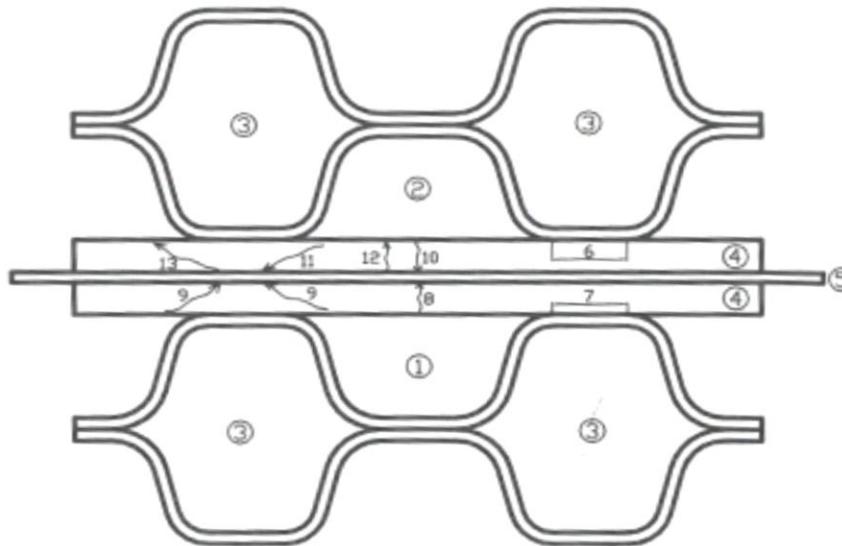
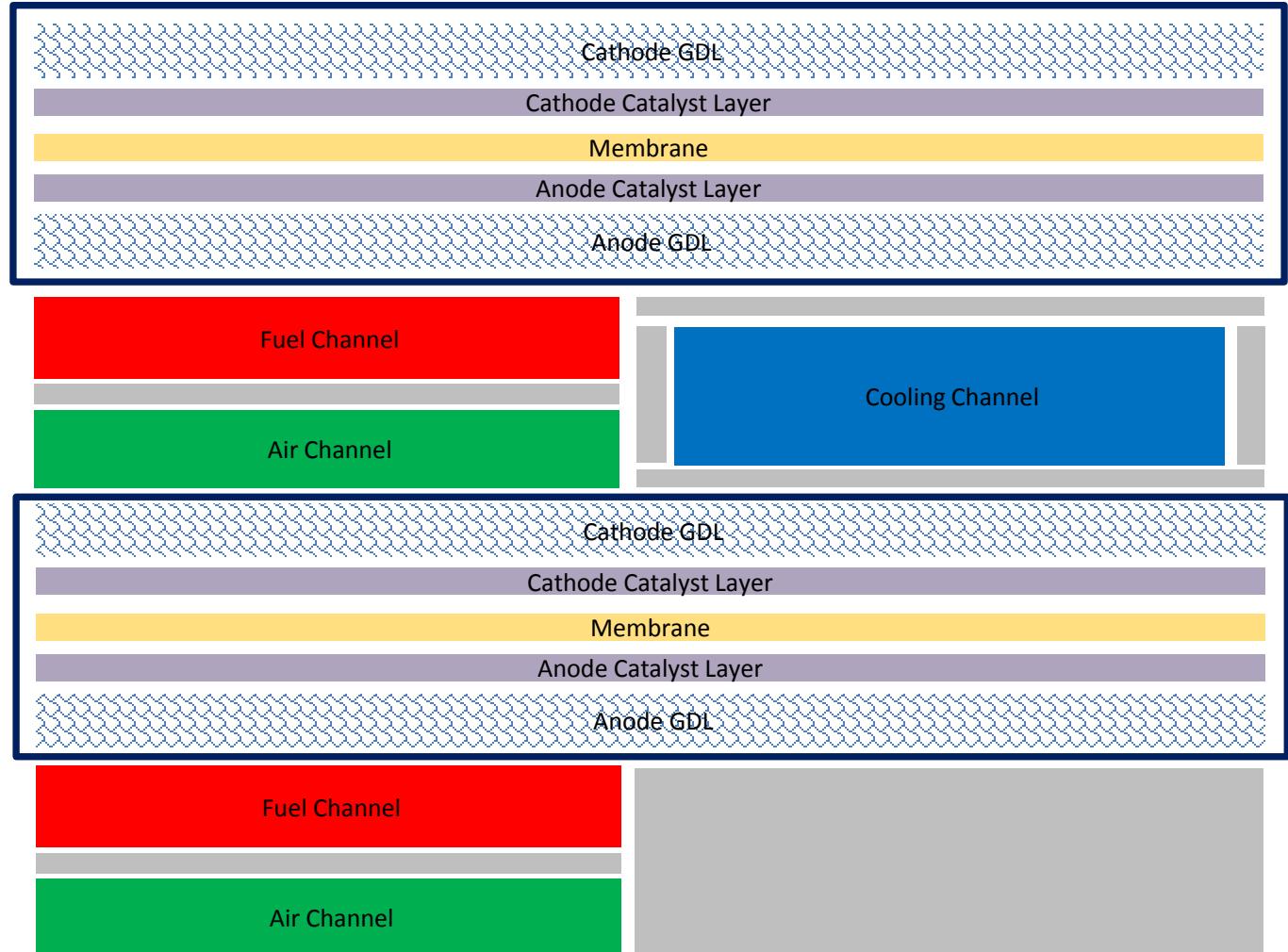


Fig. 1 Cross section of a standard cell: (1) anode channel; (2) cathode channel; (3) cooling channel; (4) gas-diffusion layer; (5) membrane; (6) cathode contact area; (7) anode contact area; (8) hydrogen diffusion length at the channel; (9) hydrogen diffusion length at the contact area; (10) oxygen diffusion length at the channel; (11) oxygen diffusion length at the contact areas; (12) water diffusion length at the channel; (13) water diffusion length at the contact areas

F.N. Buchi, M. Inaba, T.S. Schmidt "Polymer Electrolyte Fuel Cell Durability", 2009

PEM stack assembly

Electrochemistry
&
Mass Transport
from

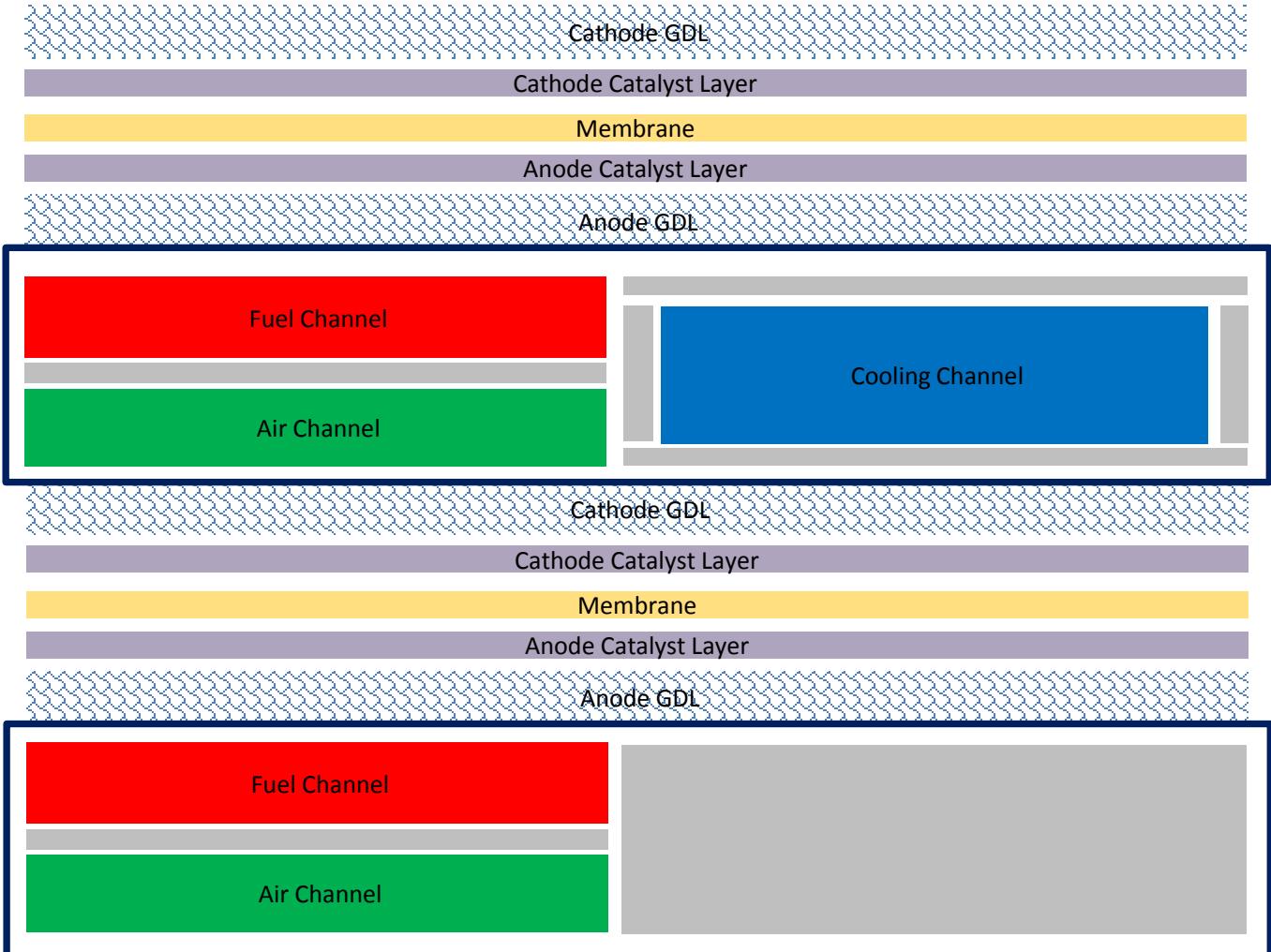


PEM stack assembly

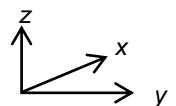
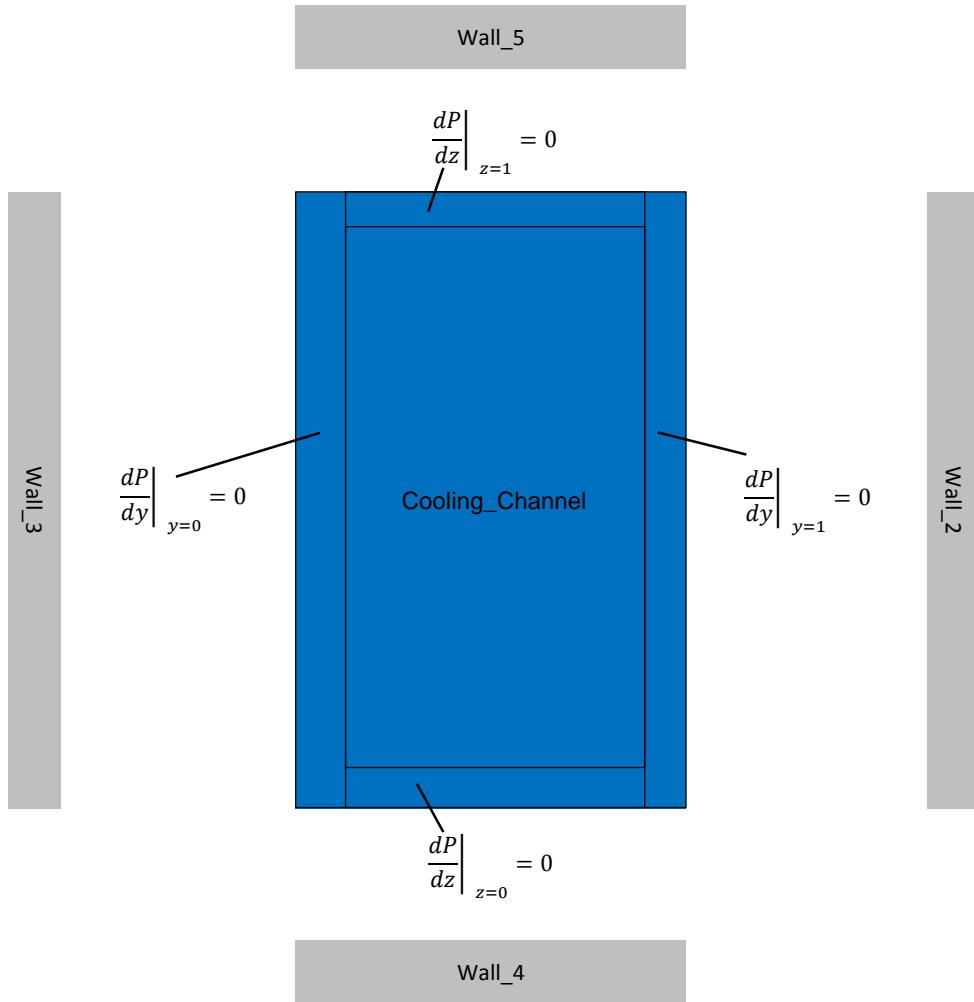
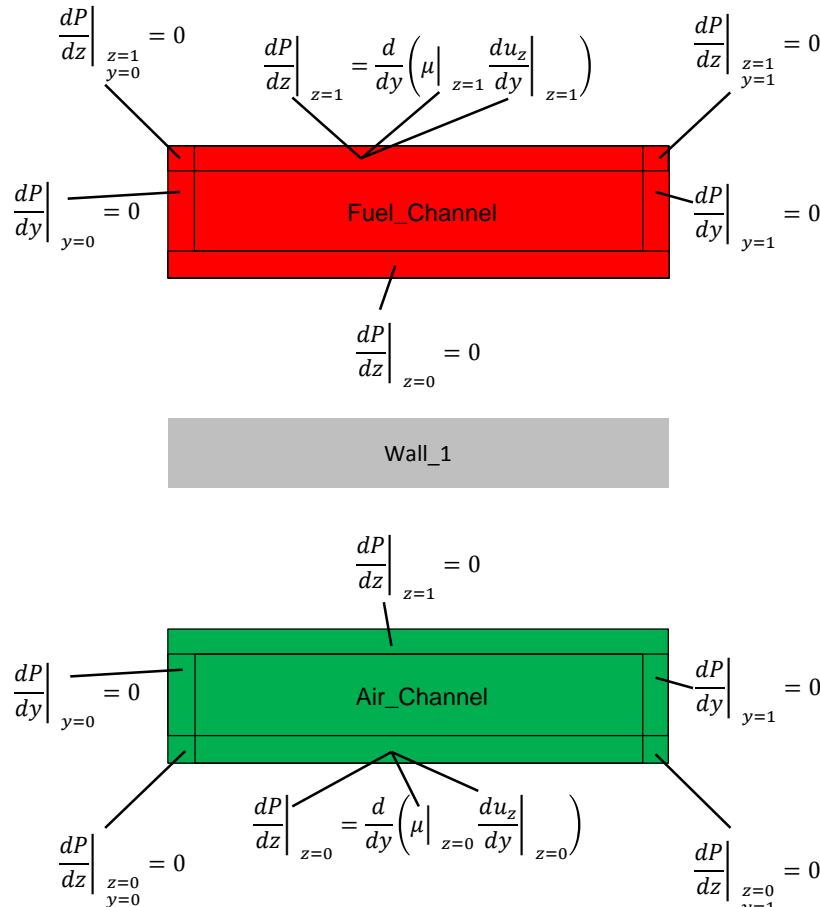
3D Navier-Stokes eq.
formulation accounting
for variation of density
and viscosity in channels

3D mass and energy
conservation equations

Convective and diffusive
mass transfer from
channels to GDLs

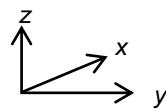
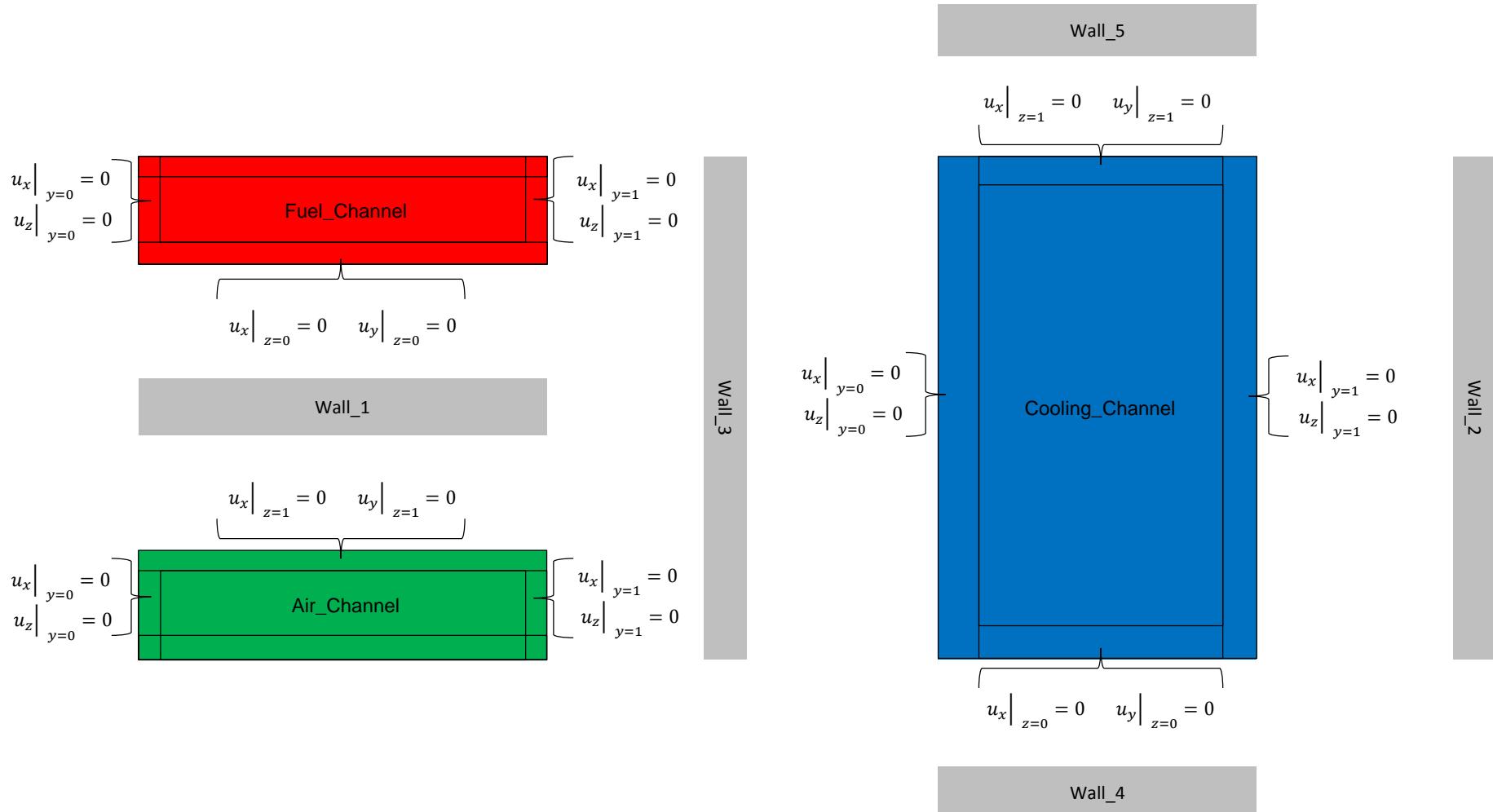


Momentum boundary conditions for channel assembly



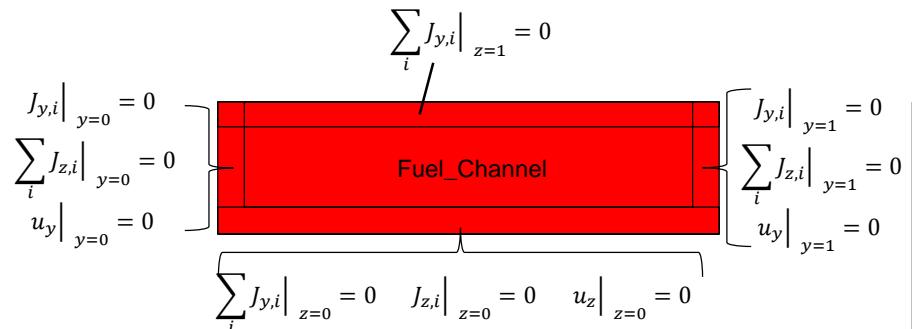
All boundary conditions apply to $x \in [0,1]$

No-slip boundary conditions for channel assembly

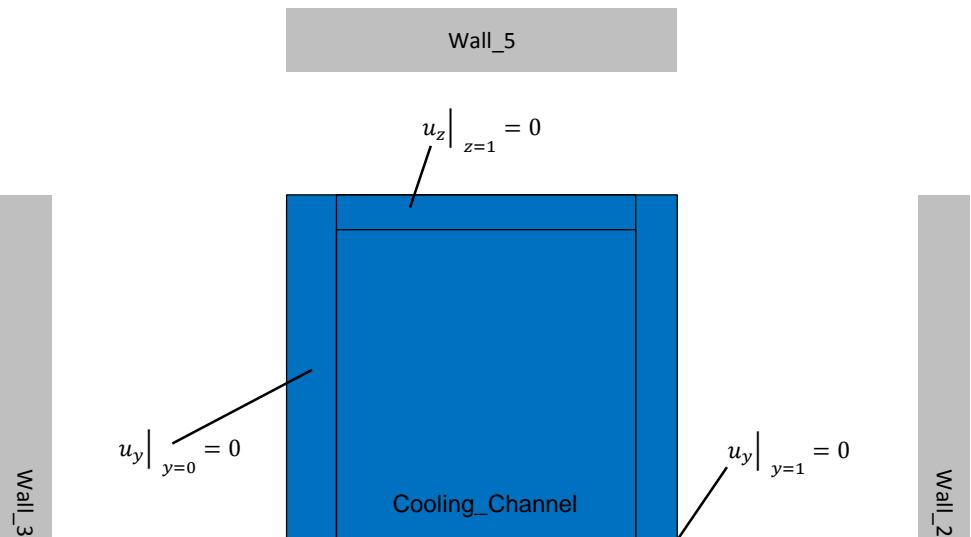


All boundary conditions apply to $x \in [0,1]$

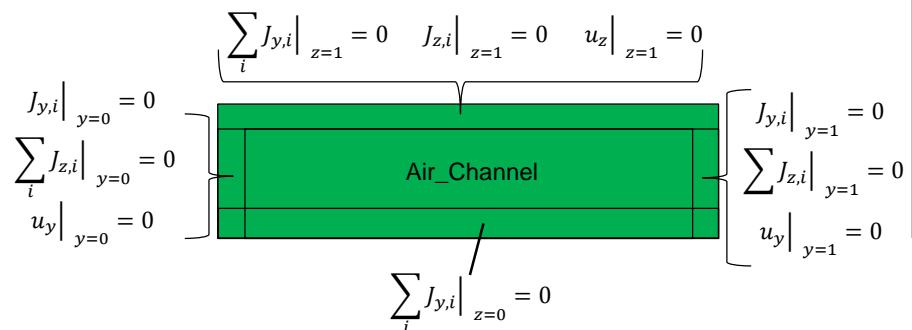
Mass boundary conditions for gas channels



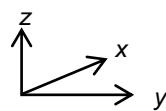
Wall_1



Wall_2

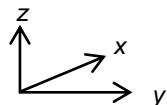
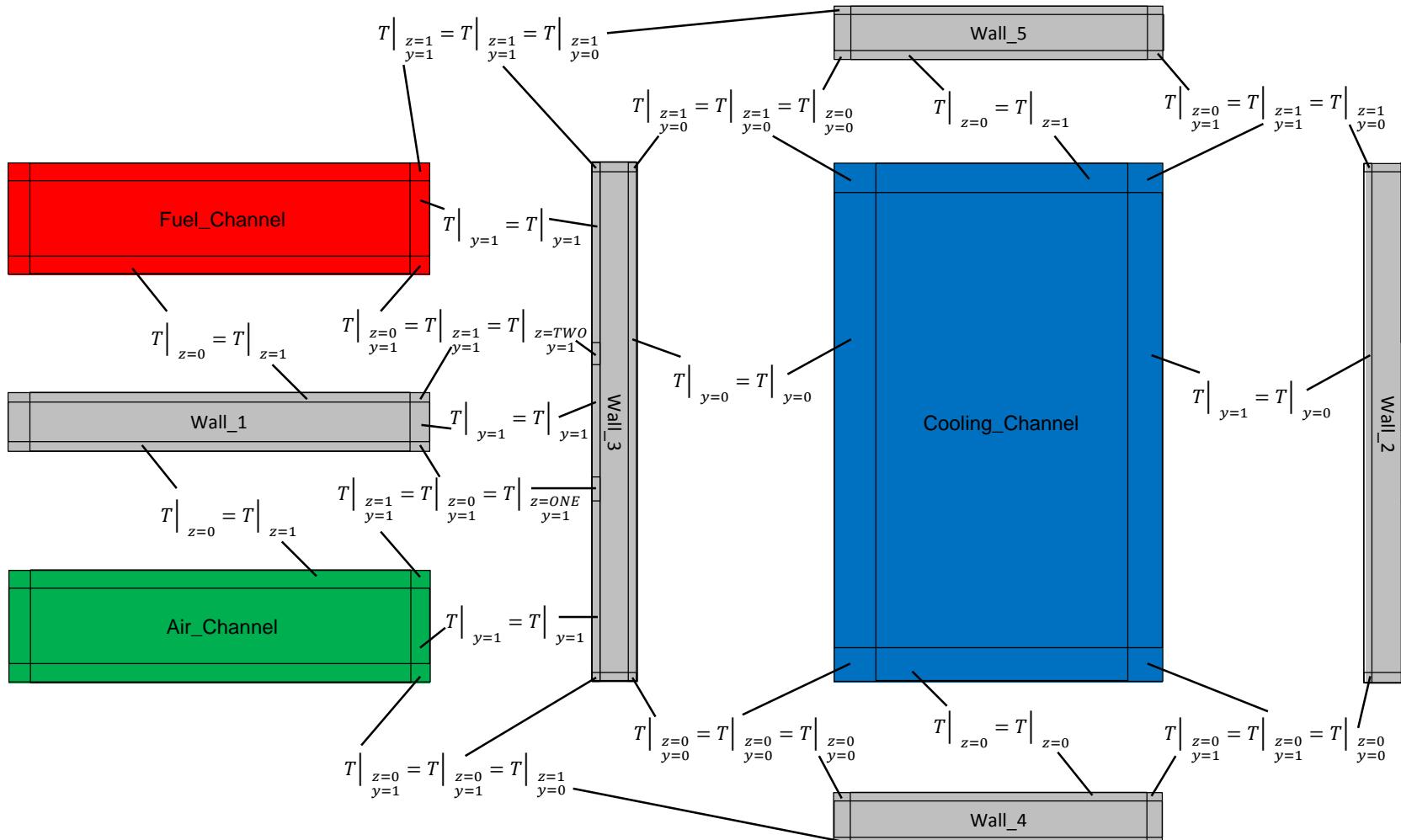


Wall_4



All boundary conditions apply to $x \in [0,1]$

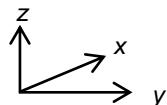
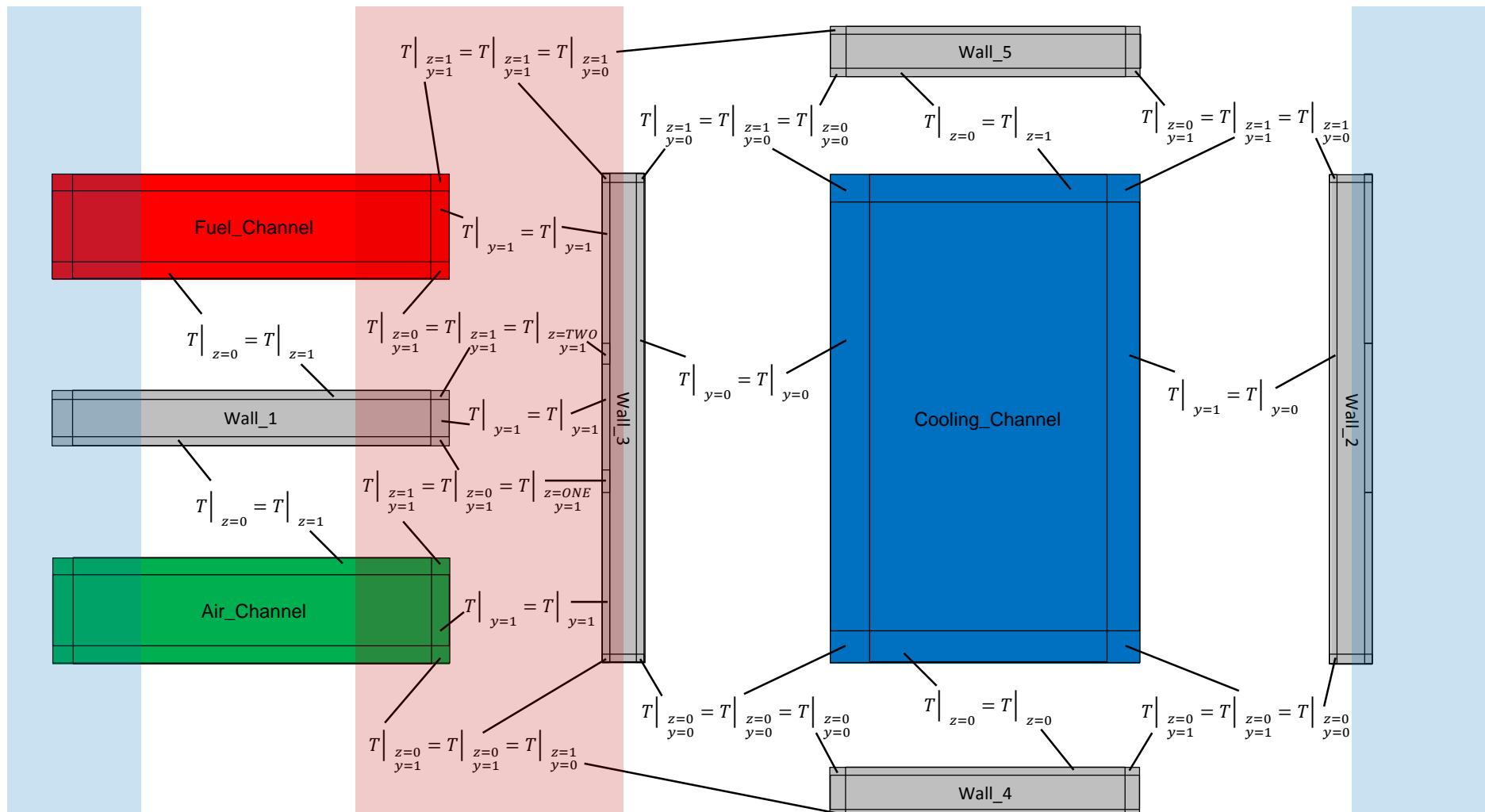
Temperature boundary conditions for channel assembly



All boundary conditions apply to $x \in [0,1]$

* ONE and TWO are points defined in the model that refer to the elements where 3 models are joined

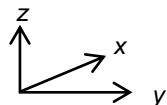
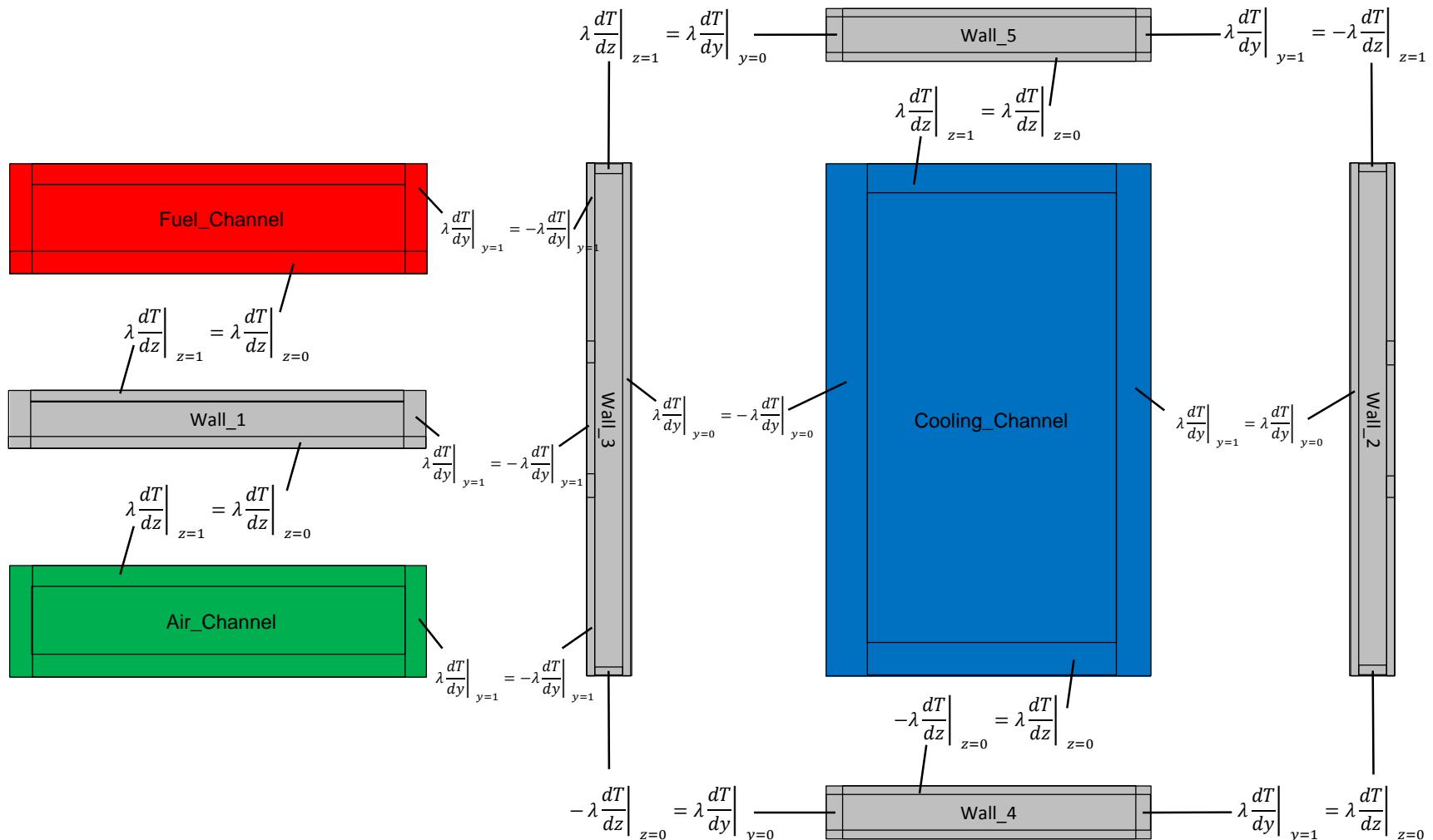
Temperature boundary conditions for channel assembly



All boundary conditions apply to $x \in [0,1]$

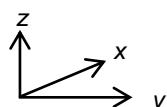
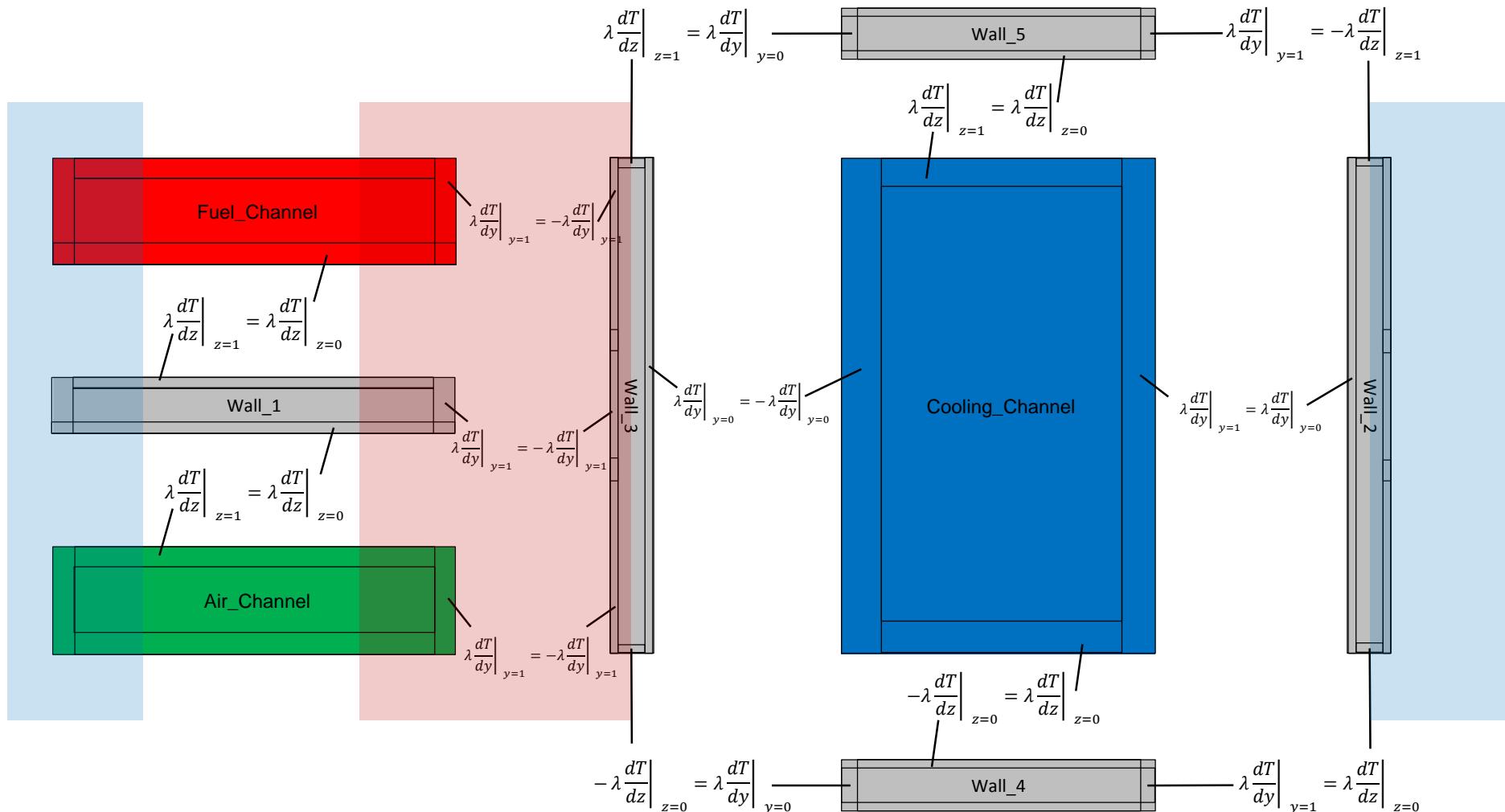
The boundary conditions in the red shaded region are repeated for the blue shaded region

Heat flux boundary conditions for channel assembly



All boundary conditions apply to $x \in [0,1]$

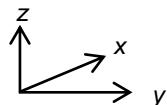
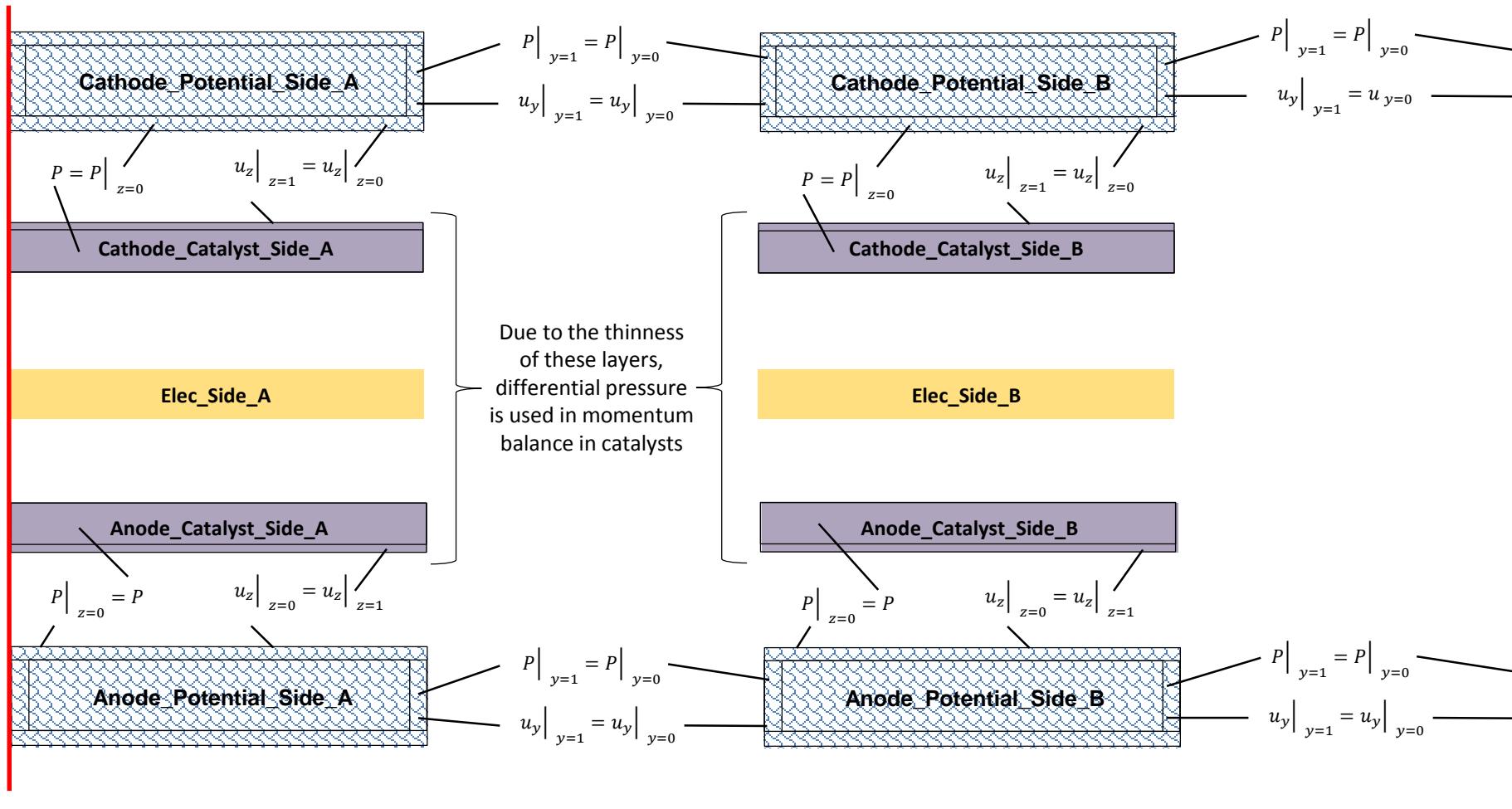
Heat flux boundary conditions for channel assembly



All boundary conditions apply to $x \in [0,1]$

The boundary conditions in the red shaded region are repeated for the blue shaded region

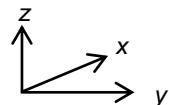
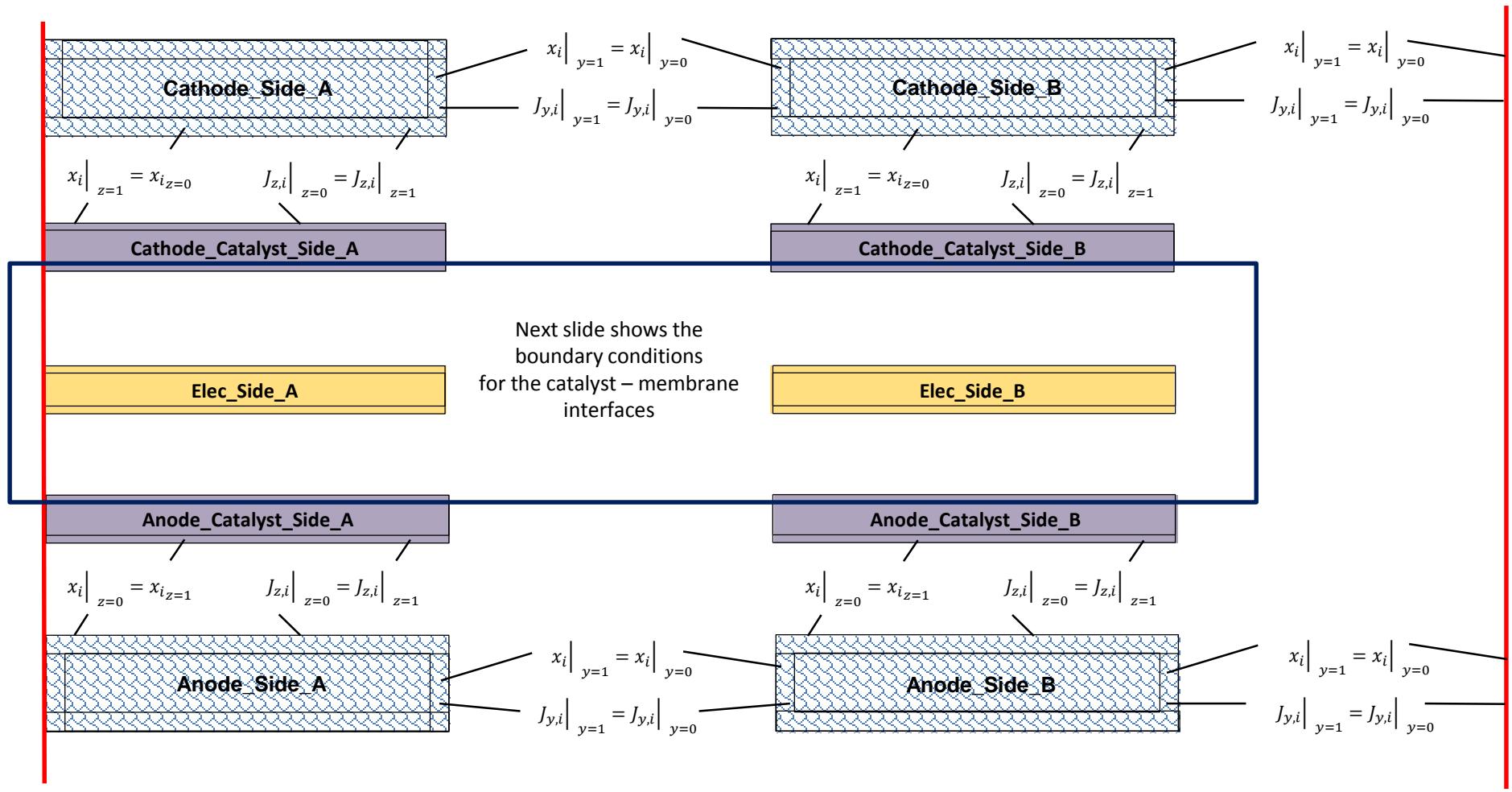
Momentum boundary conditions for MEA



All boundary conditions apply to $x \in [0,1]$

* red lines represent the same boundary

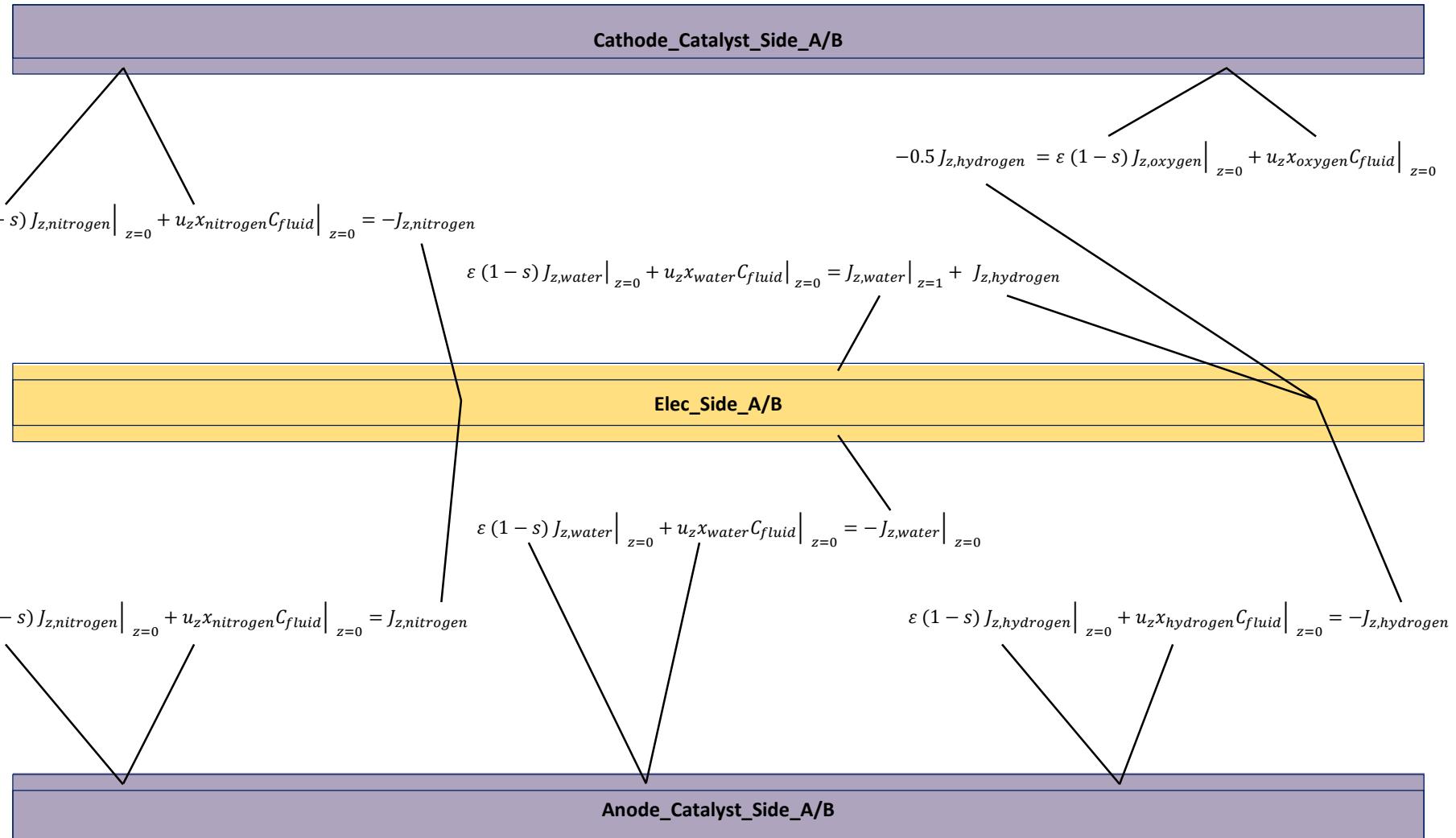
Mass boundary conditions for MEA



All boundary conditions apply to $x \in [0,1]$

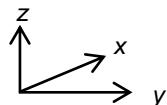
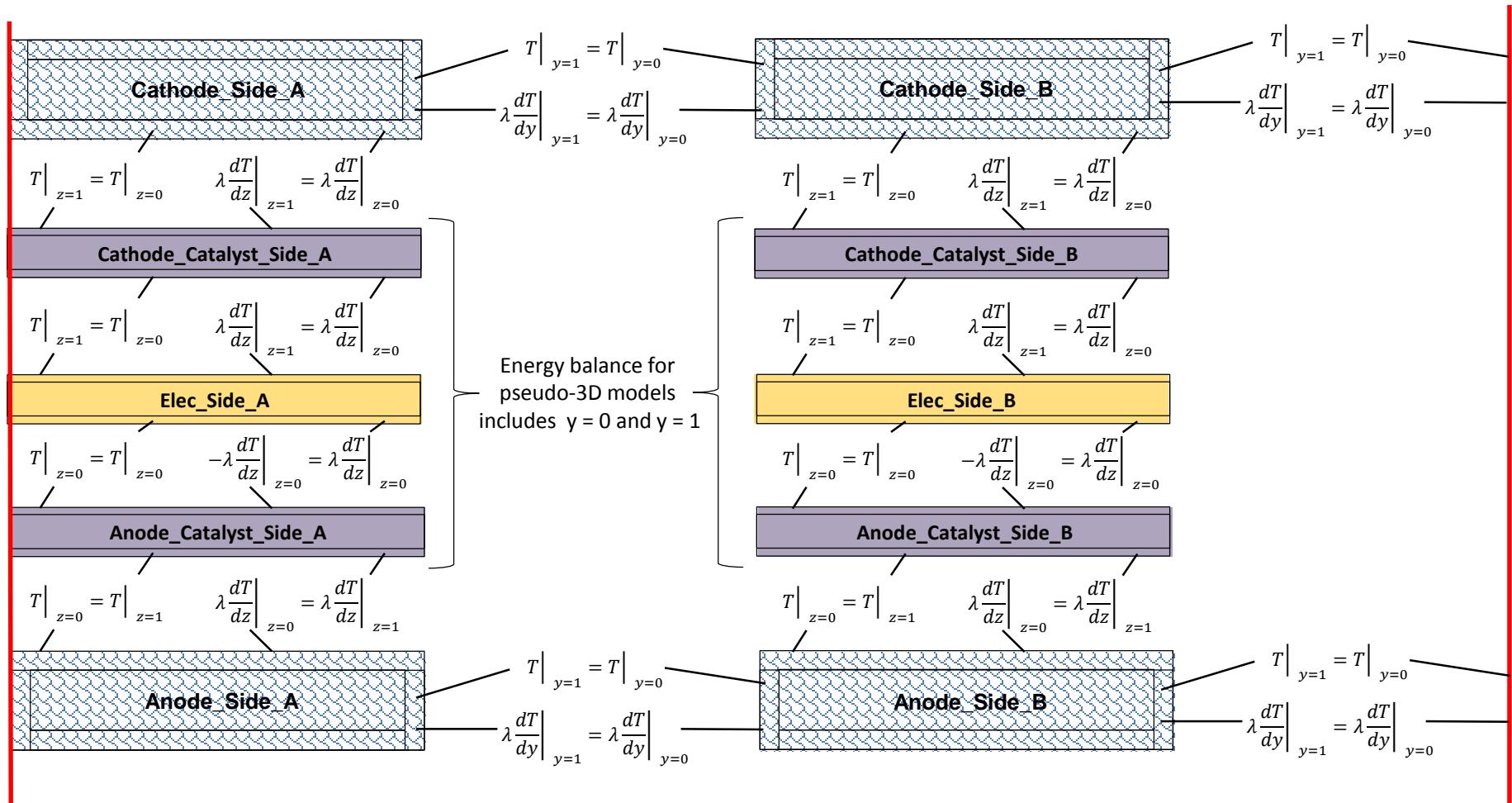
* red lines represent the same boundary

Mass boundary conditions at membrane – catalyst interfaces



All boundary conditions apply to $x \in [0,1]$

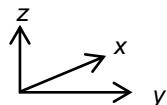
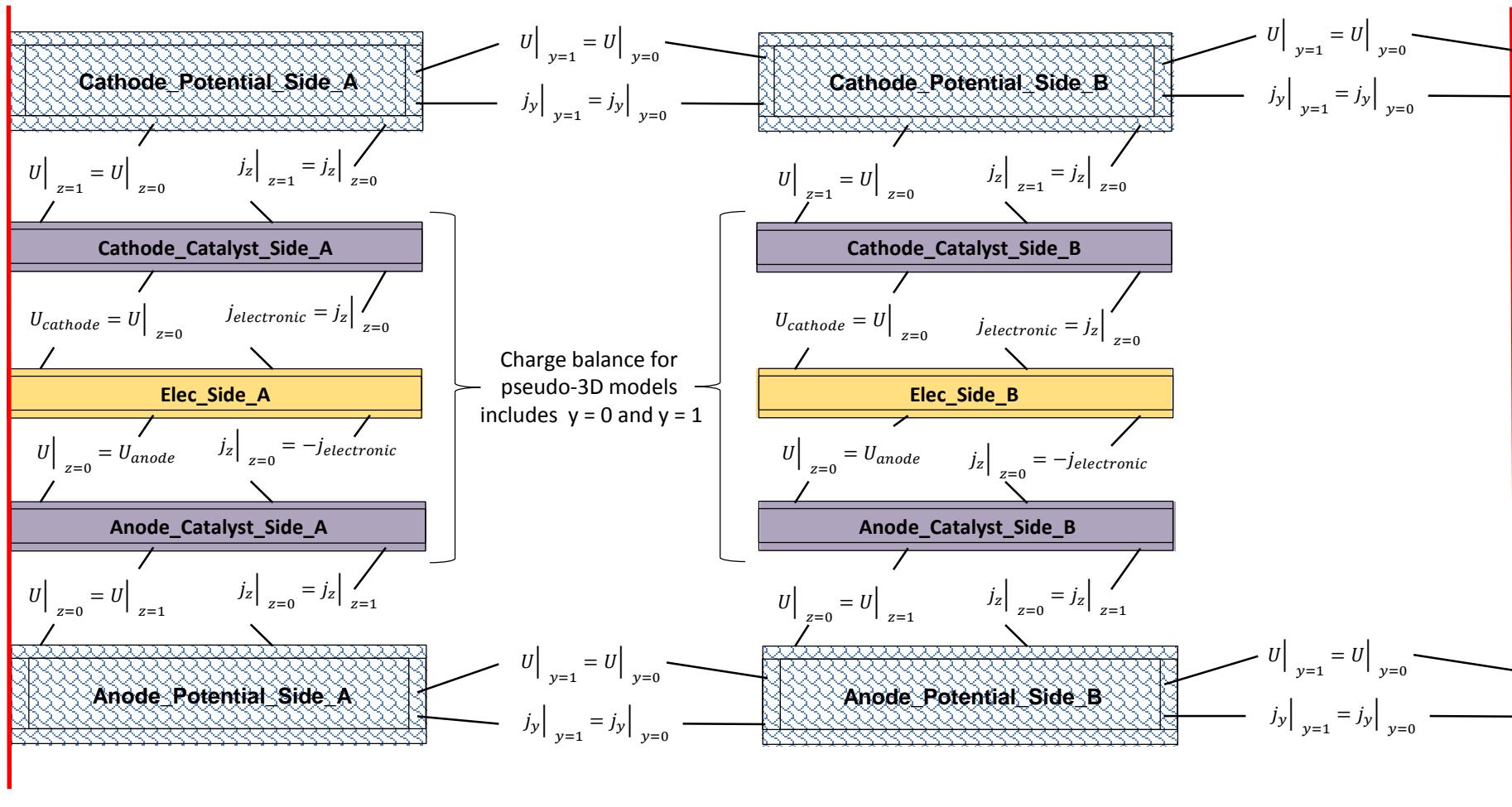
Energy boundary conditions for MEA



All boundary conditions apply to $x \in [0,1]$

* red lines represent the same boundary

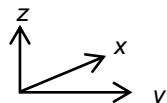
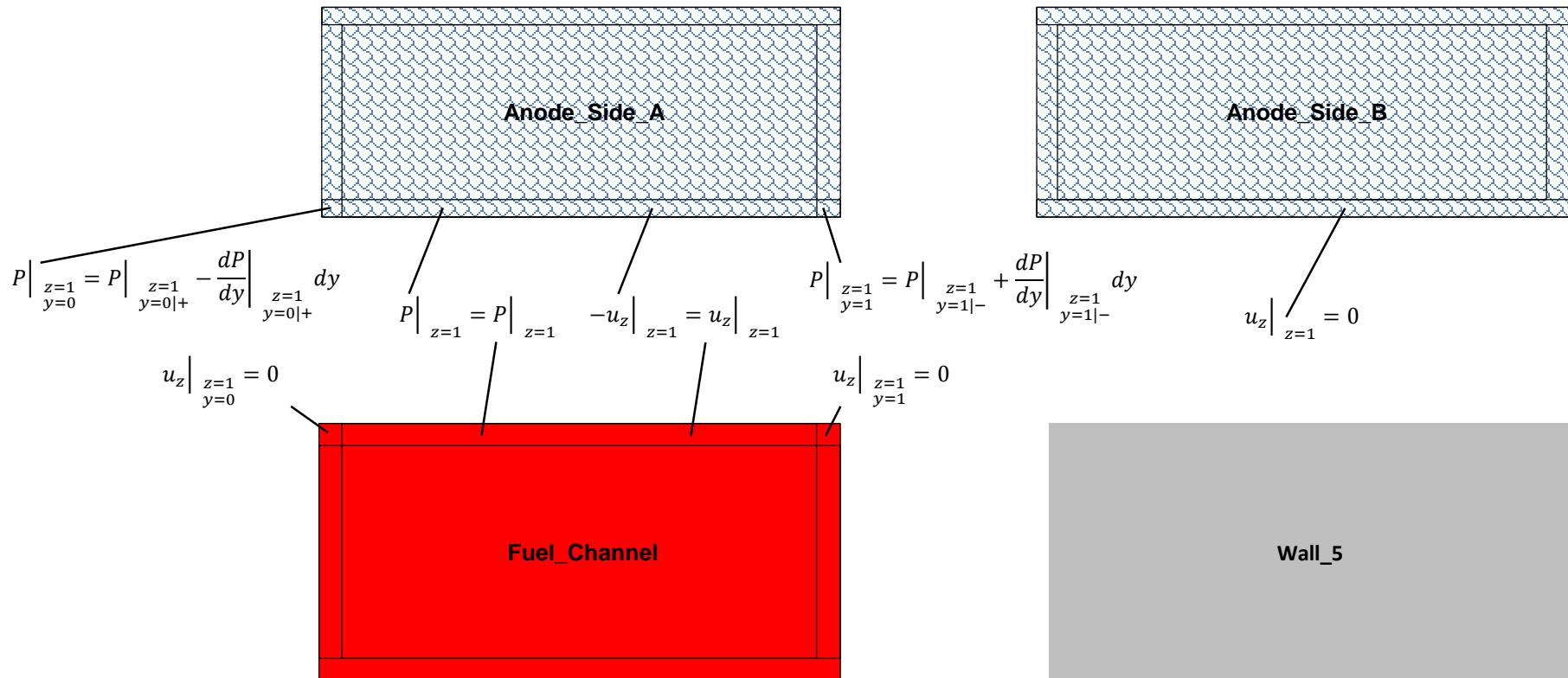
Current boundary conditions for MEA



All boundary conditions apply to $x \in [0,1]$

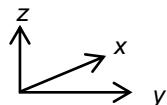
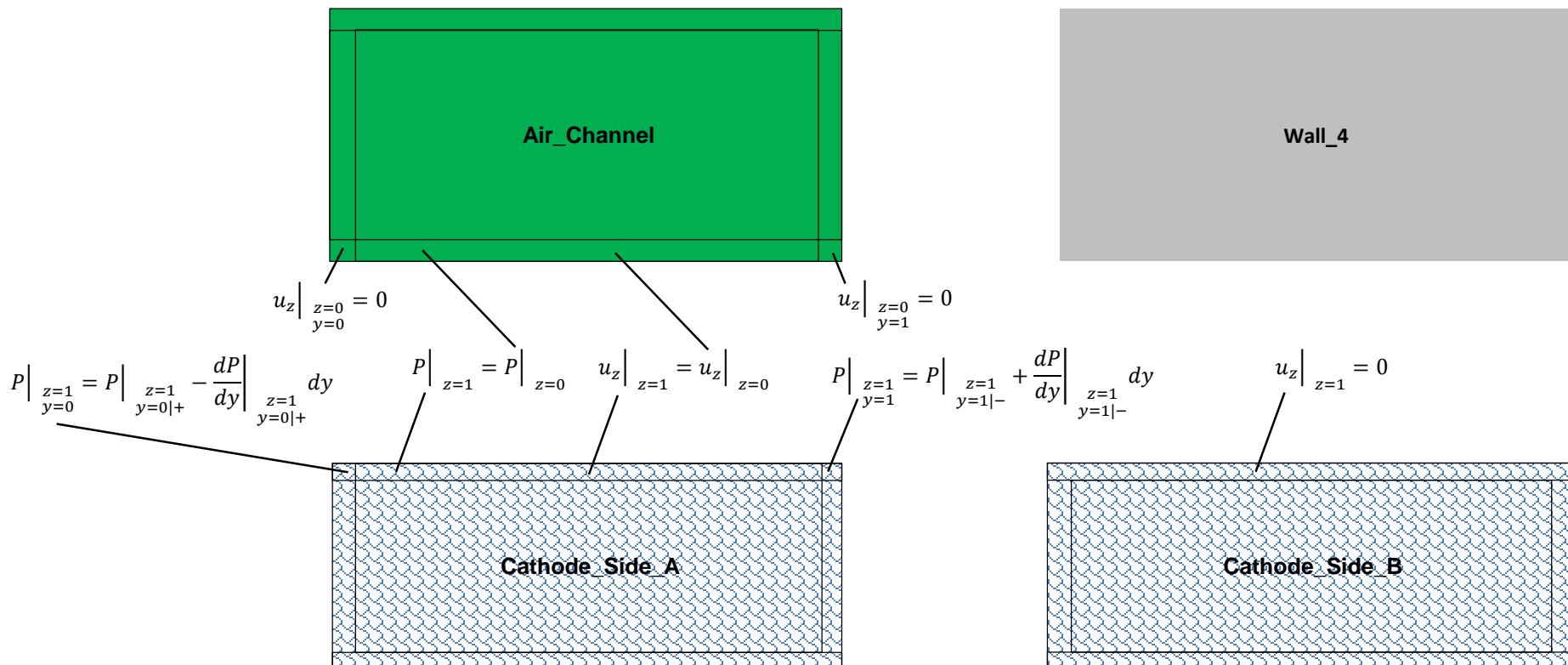
* red lines represent the same boundary

Momentum boundary conditions for fuel channel – GDL interface



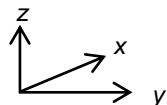
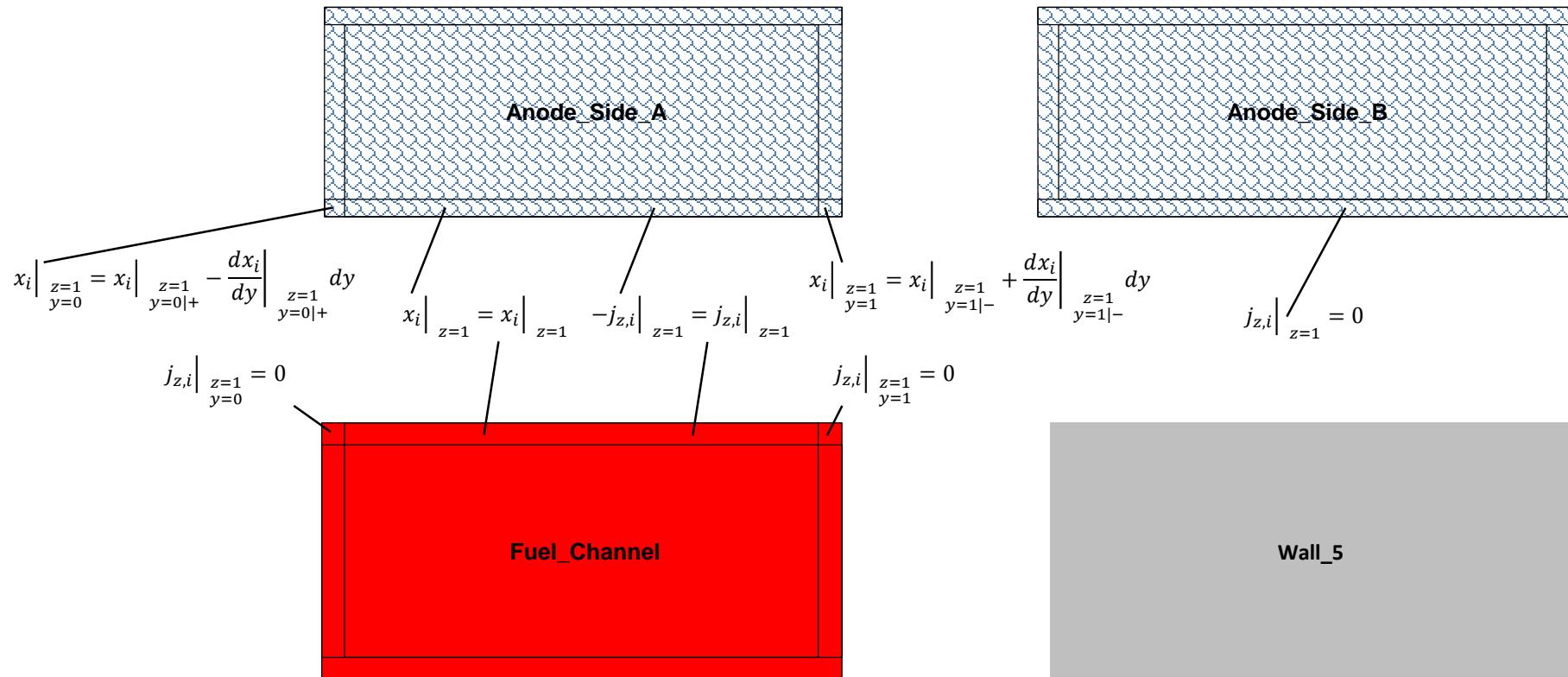
All boundary conditions apply to $x \in [0,1]$

Momentum boundary conditions for air channel – GDL interface



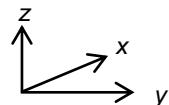
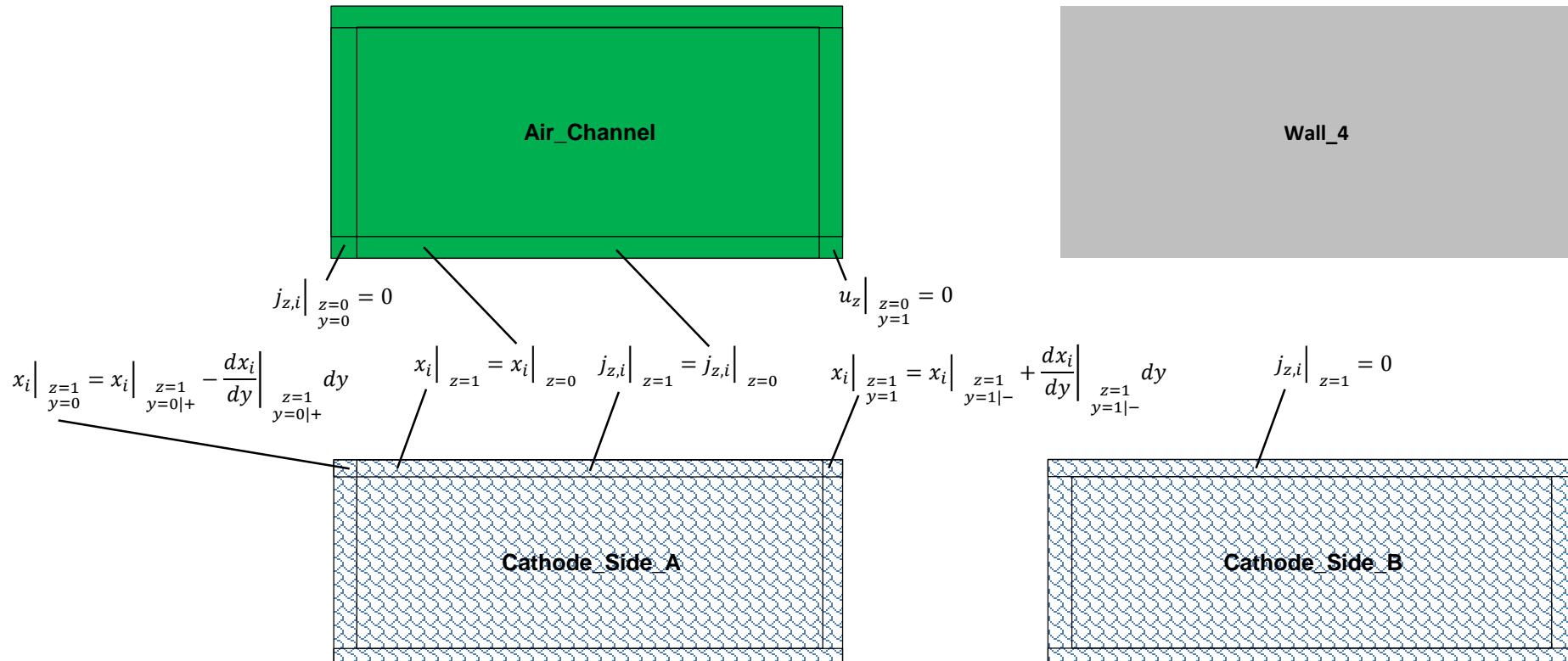
All boundary conditions apply to $x \in [0,1]$

Mass boundary conditions for fuel channel – GDL interface



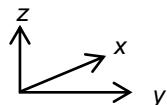
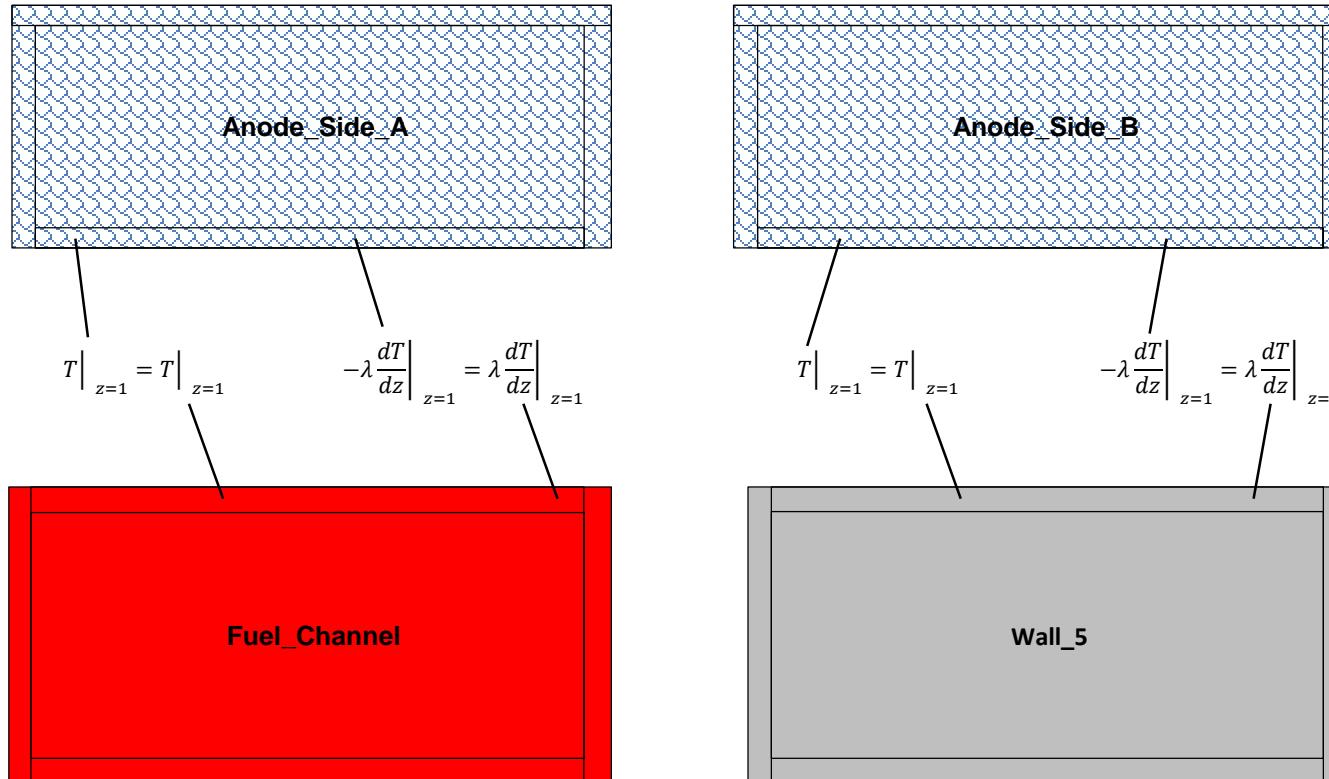
All boundary conditions apply to $x \in [0,1]$

Mass boundary conditions for air channel – GDL interface



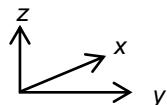
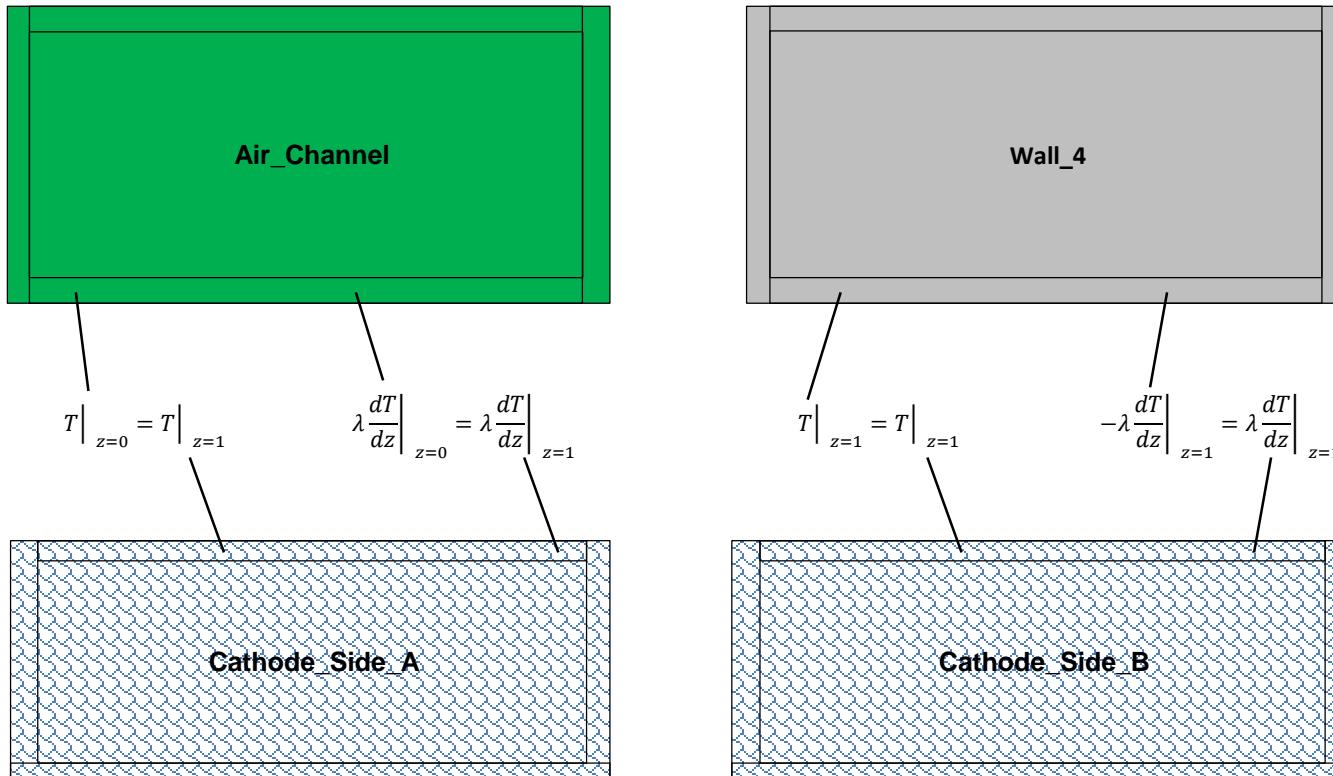
All boundary conditions apply to $x \in [0,1]$

Energy boundary conditions for fuel channel – GDL interface



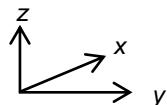
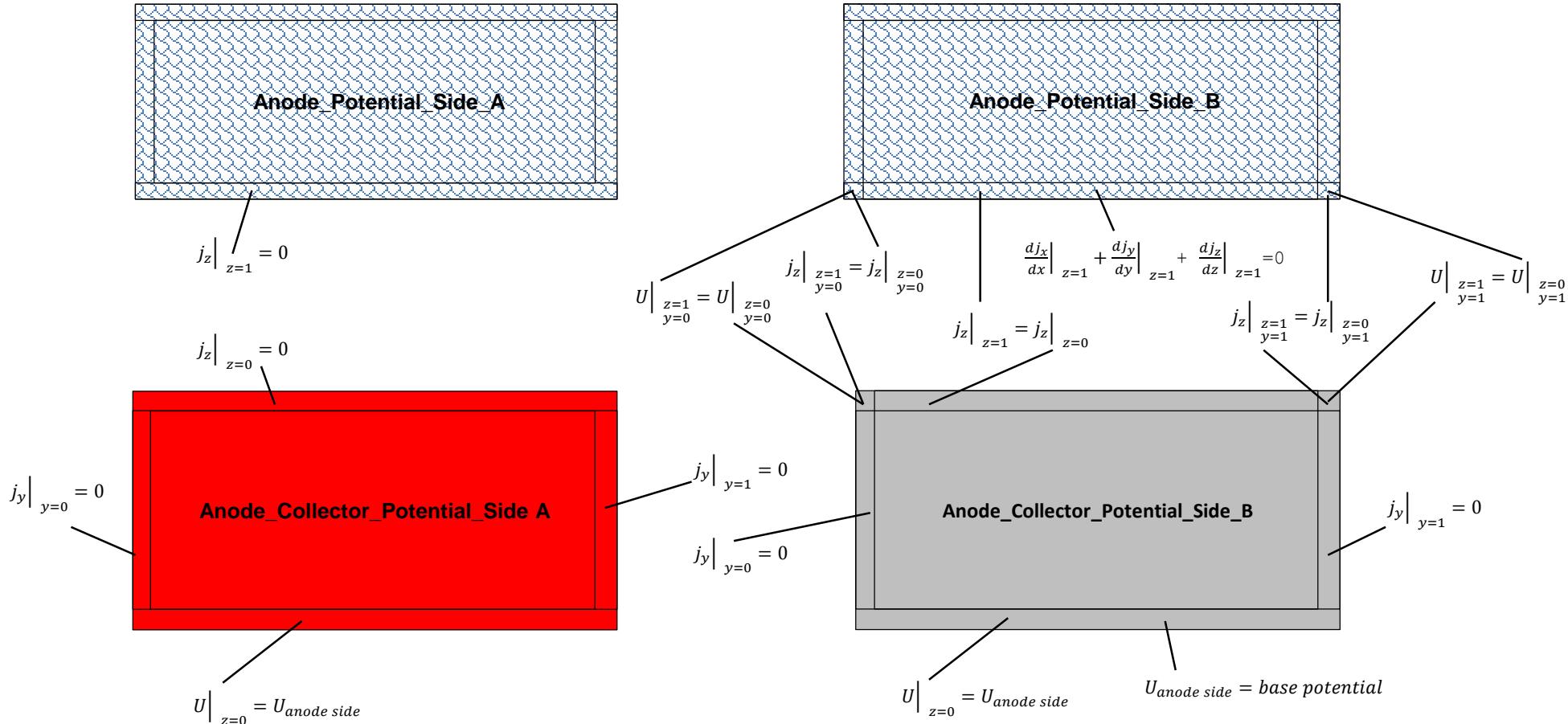
All boundary conditions apply to $x \in [0,1]$

Energy boundary conditions for air channel – GDL interface



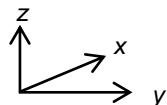
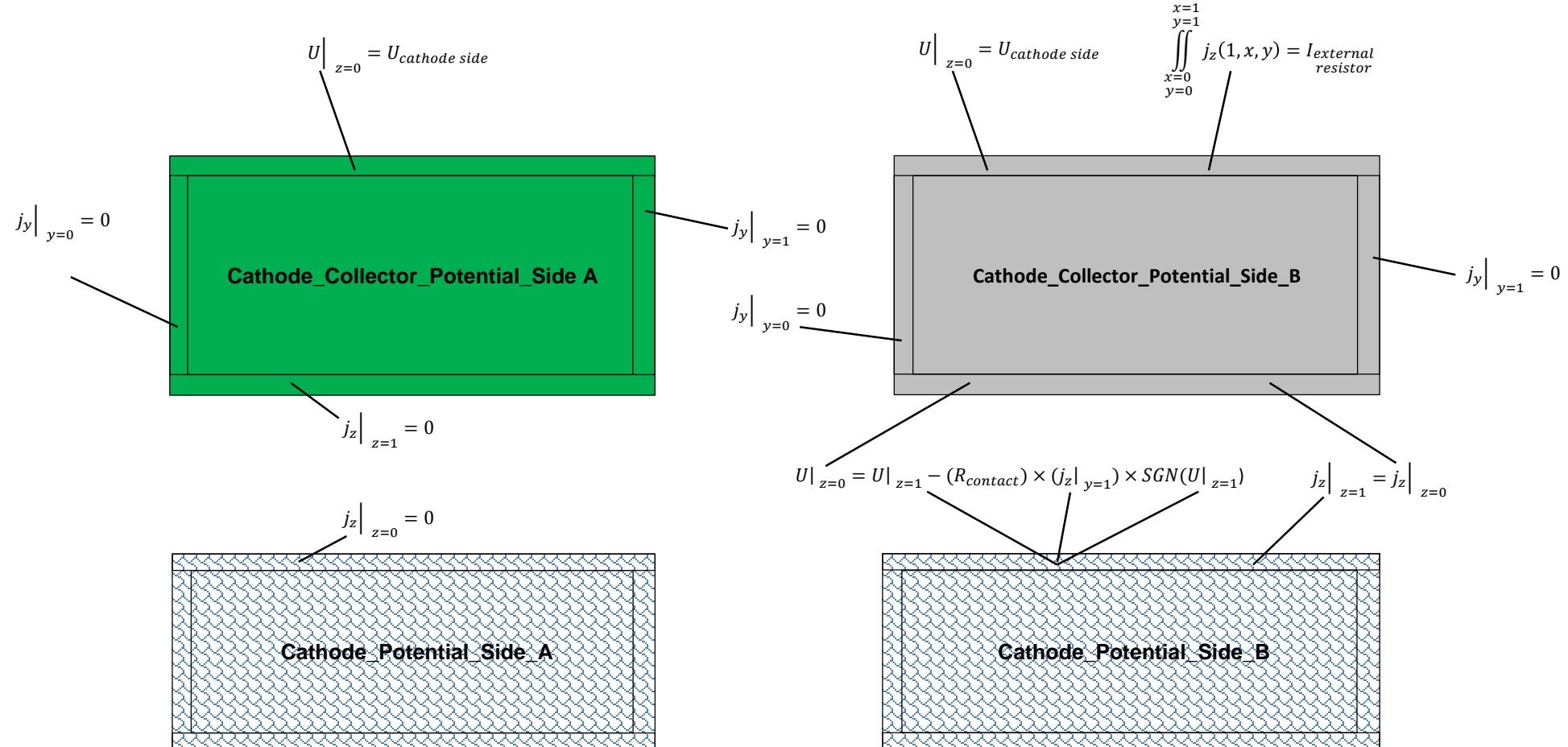
All boundary conditions apply to $x \in [0,1]$

Potential boundary conditions for lands – anode GDL interface



All boundary conditions apply to $x \in [0,1]$

Potential boundary conditions for lands – cathode GDL interface

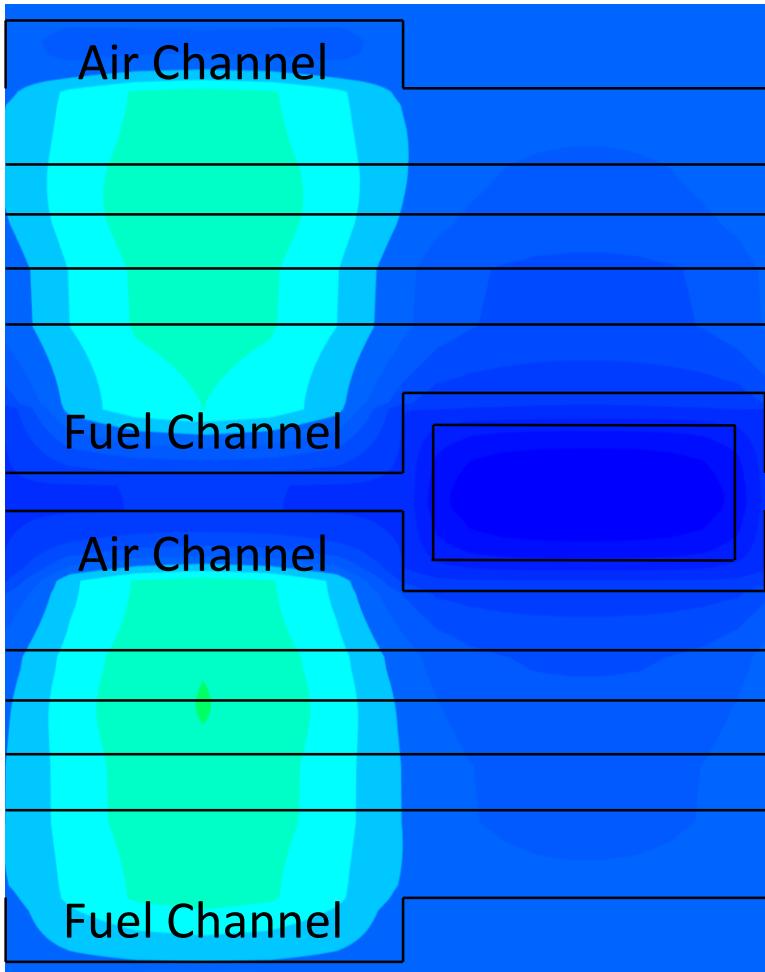
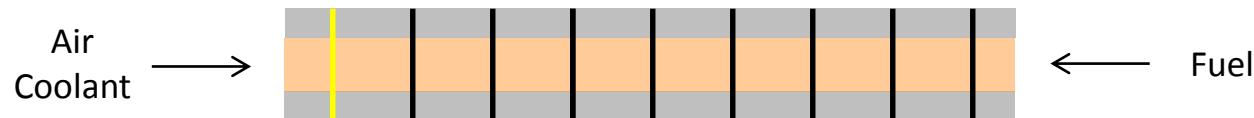


All boundary conditions apply to $x \in [0,1]$



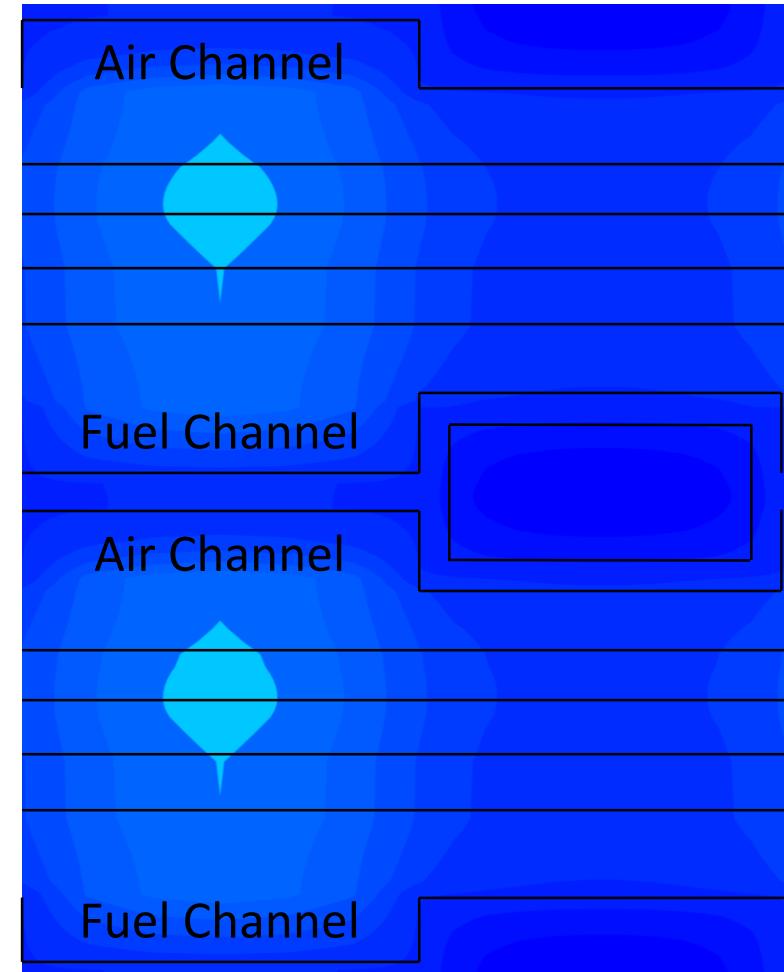
Temperature profile in channels and MEA

Temperature profile (375A)

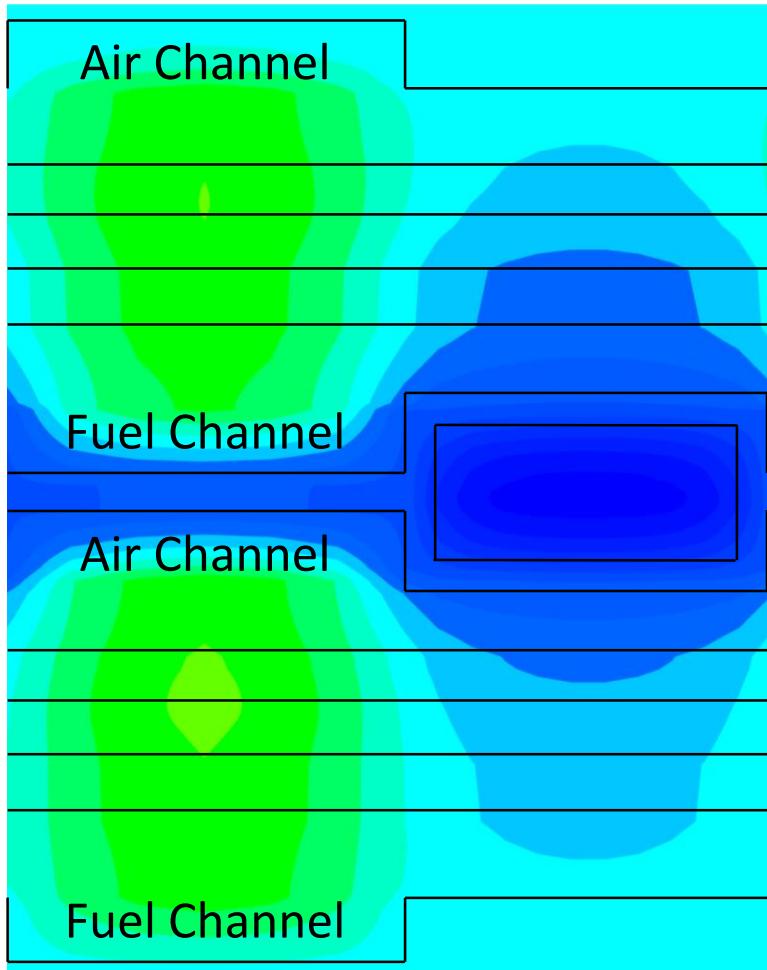


Temperature (K)

- 354.25-354.9
- 353.6-354.25
- 352.95-353.6
- 352.3-352.95
- 351.65-352.3
- 351-351.65
- 350.35-351
- 349.7-350.35
- 349.05-349.7
- 348.4-349.05
- 347.75-348.4
- 347.1-347.75
- 346.45-347.1
- 345.8-346.45
- 345.15-345.8
- 344.5-345.15
- 343.85-344.5
- 343.2-343.85

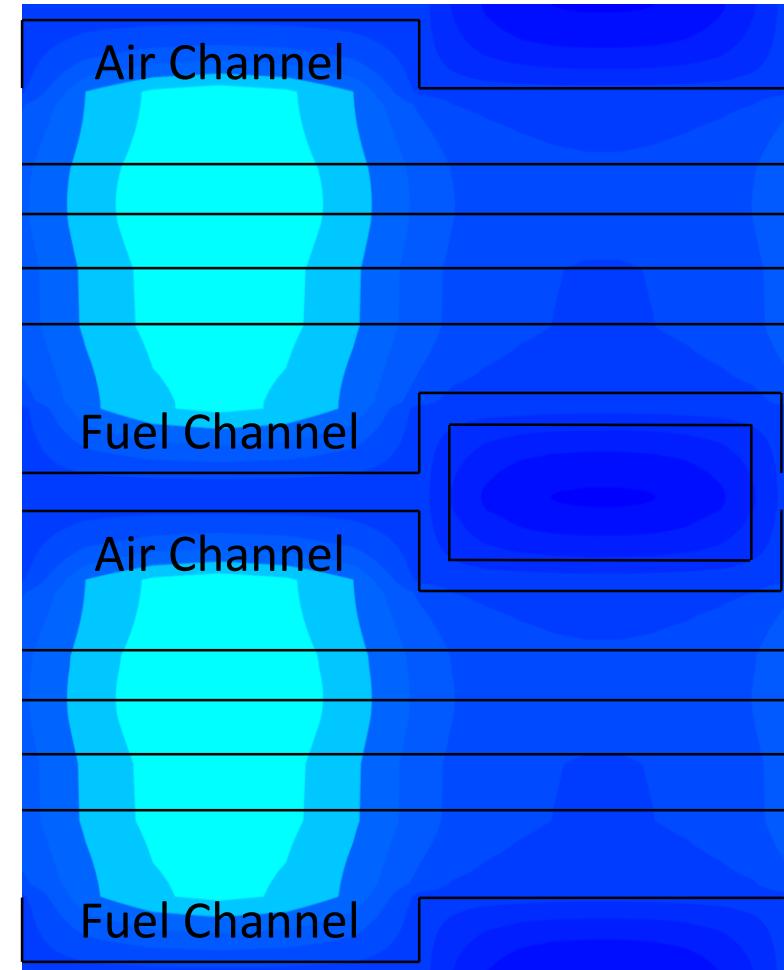


Temperature profile (375A)

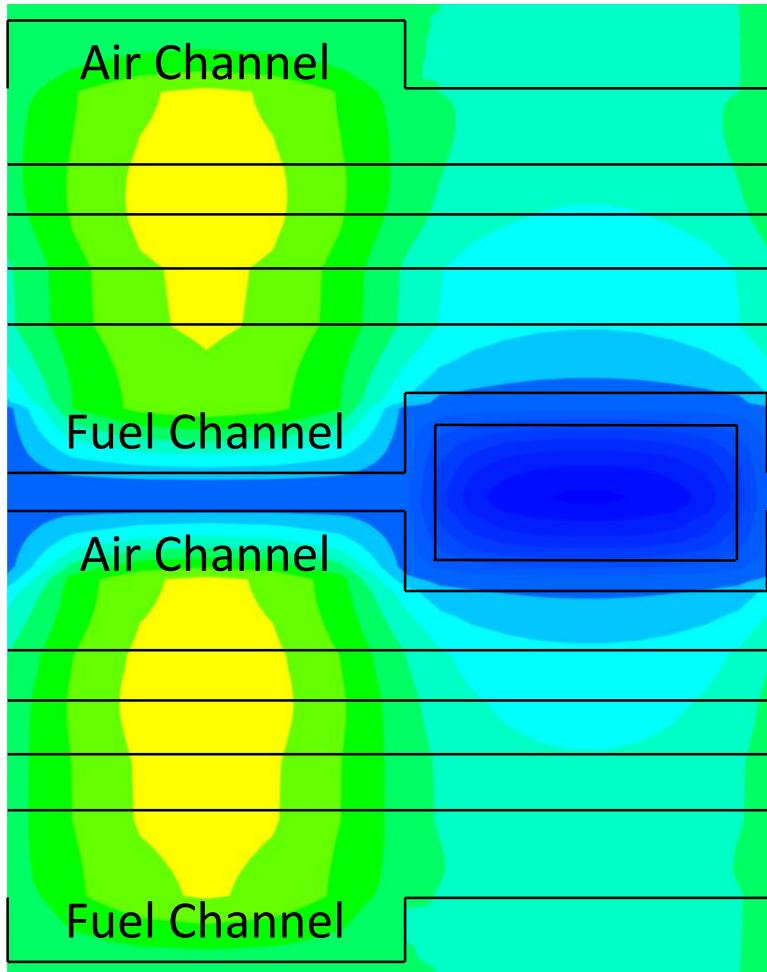
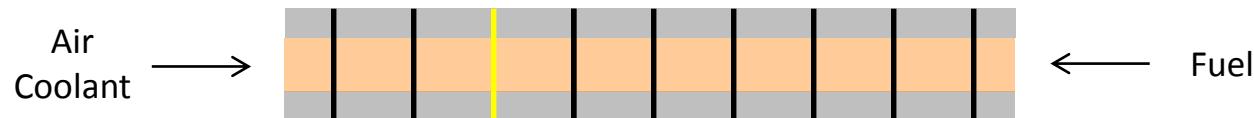


Temperature (K)

- 354.25-354.9
- 353.6-354.25
- 352.95-353.6
- 352.3-352.95
- 351.65-352.3
- 351-351.65
- 350.35-351
- 349.7-350.35
- 349.05-349.7
- 348.4-349.05
- 347.75-348.4
- 347.1-347.75
- 346.45-347.1
- 345.8-346.45
- 345.15-345.8
- 344.5-345.15
- 343.85-344.5
- 343.2-343.85

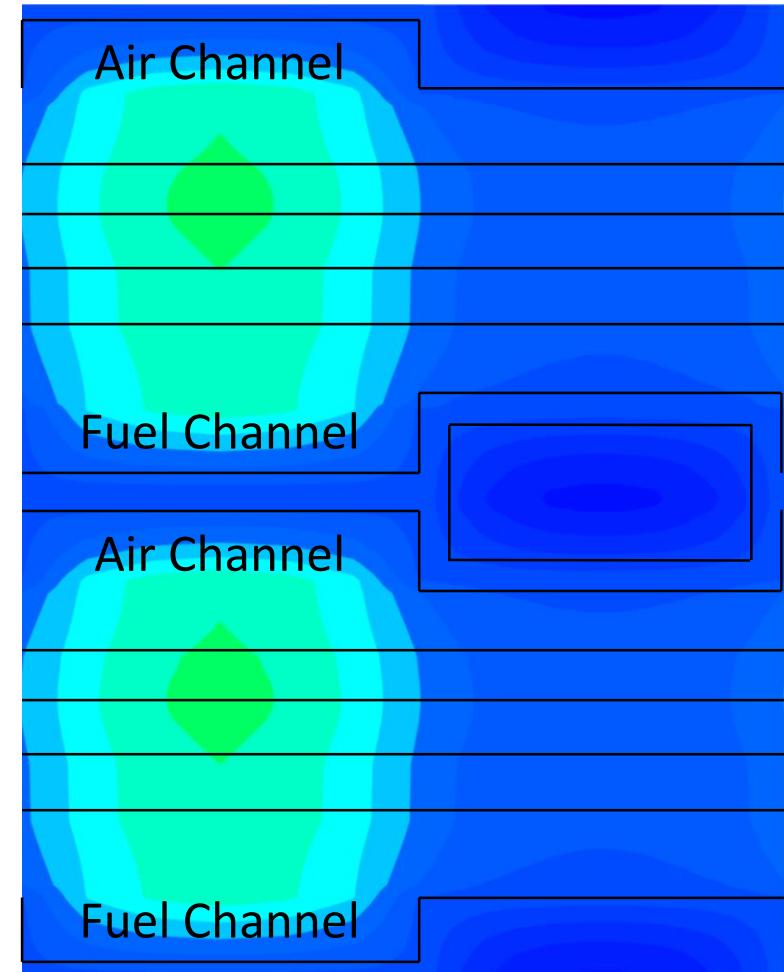


Temperature profile (375A)

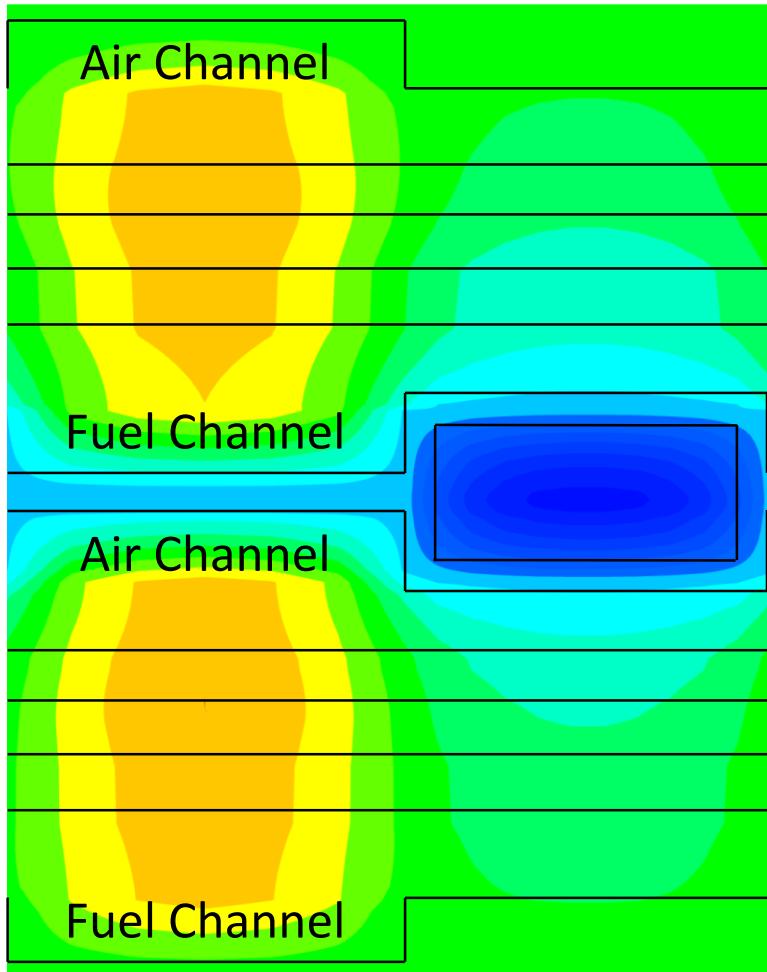


Temperature (K)

- 354.25-354.9
- 353.6-354.25
- 352.95-353.6
- 352.3-352.95
- 351.65-352.3
- 351-351.65
- 350.35-351
- 349.7-350.35
- 349.05-349.7
- 348.4-349.05
- 347.75-348.4
- 347.1-347.75
- 346.45-347.1
- 345.8-346.45
- 345.15-345.8
- 344.5-345.15
- 343.85-344.5
- 343.2-343.85

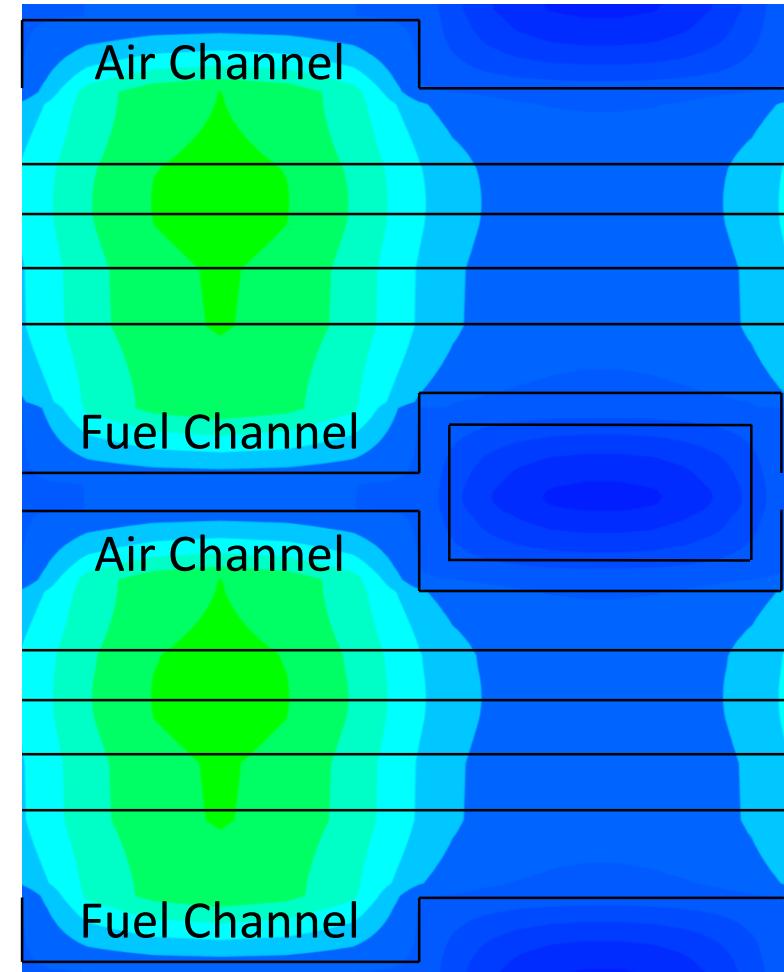


Temperature profile (375A)

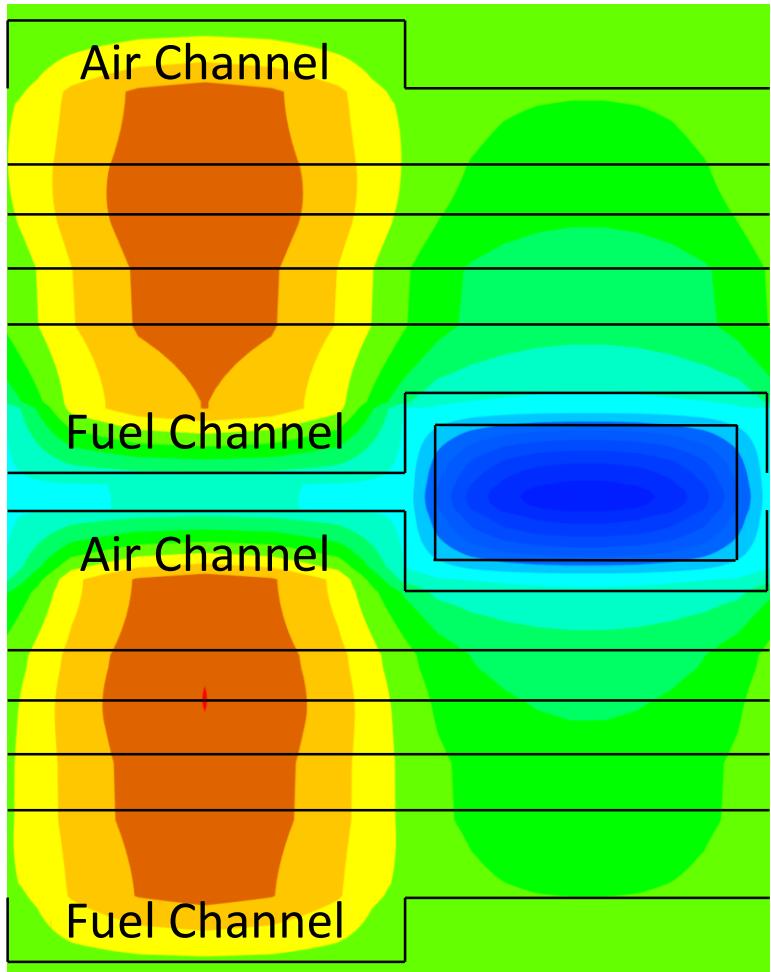


Temperature (K)

- 354.25-354.9
- 353.6-354.25
- 352.95-353.6
- 352.3-352.95
- 351.65-352.3
- 351-351.65
- 350.35-351
- 349.7-350.35
- 349.05-349.7
- 348.4-349.05
- 347.75-348.4
- 347.1-347.75
- 346.45-347.1
- 345.8-346.45
- 345.15-345.8
- 344.5-345.15
- 343.85-344.5
- 343.2-343.85

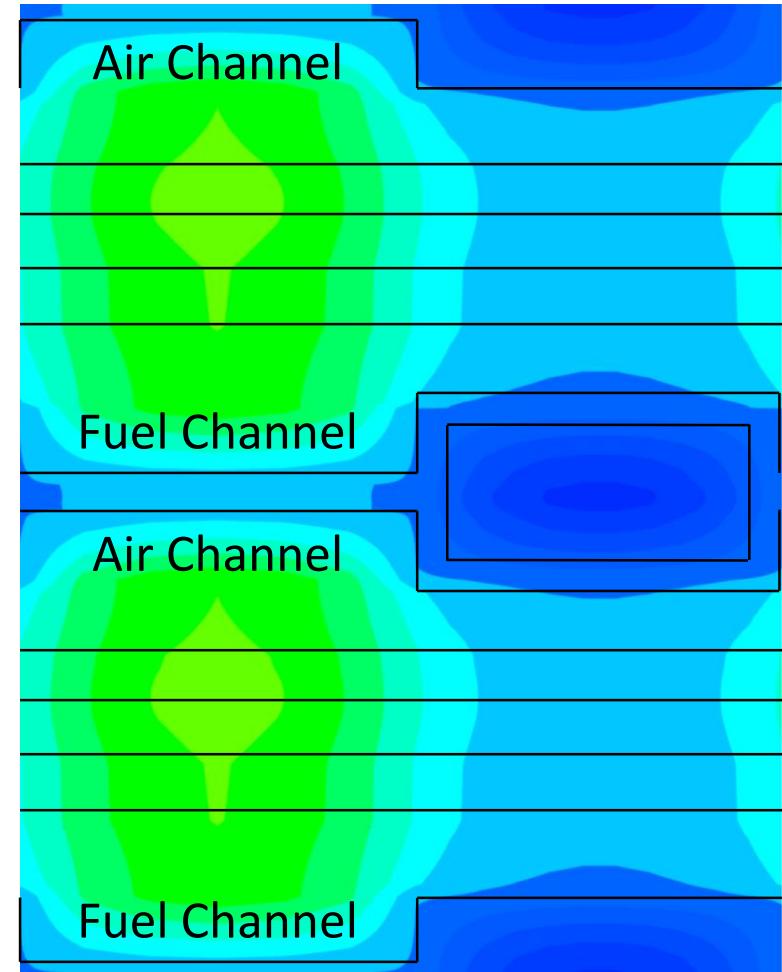


Temperature profile (375A)

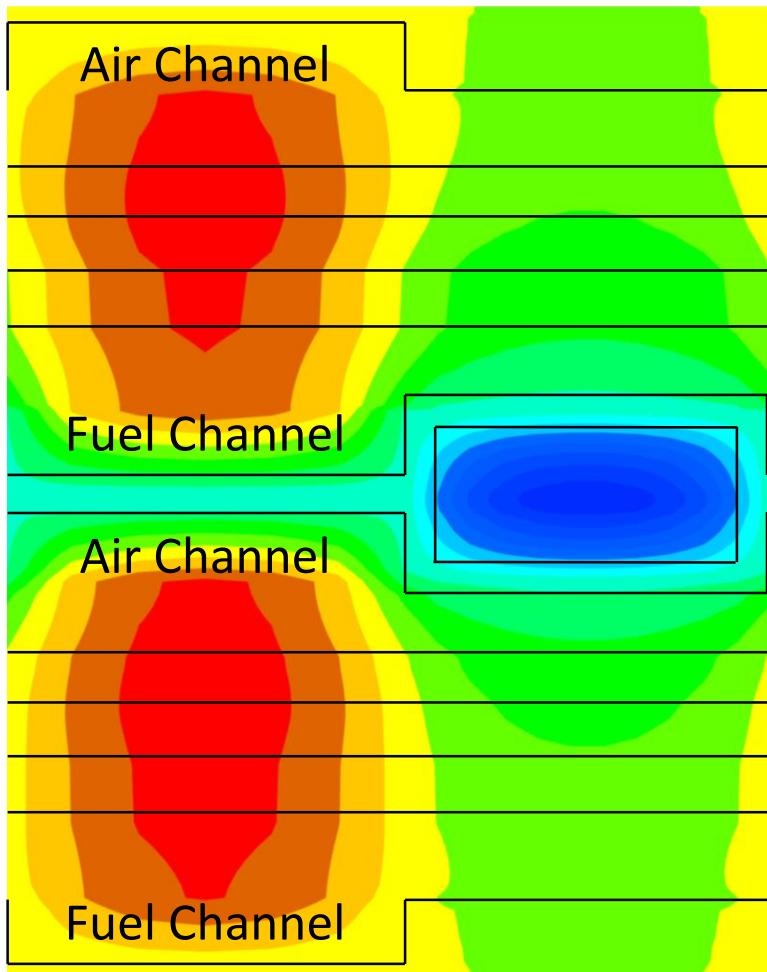
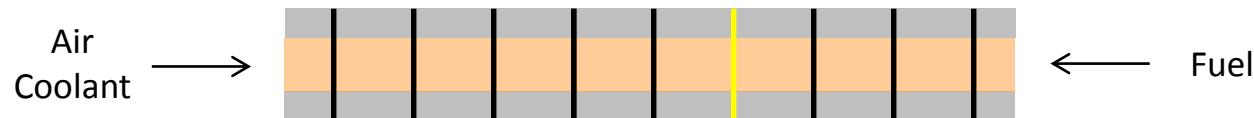


Temperature (K)

- 354.25-354.9
- 353.6-354.25
- 352.95-353.6
- 352.3-352.95
- 351.65-352.3
- 351-351.65
- 350.35-351
- 349.7-350.35
- 349.05-349.7
- 348.4-349.05
- 347.75-348.4
- 347.1-347.75
- 346.45-347.1
- 345.8-346.45
- 345.15-345.8
- 344.5-345.15
- 343.85-344.5
- 343.2-343.85

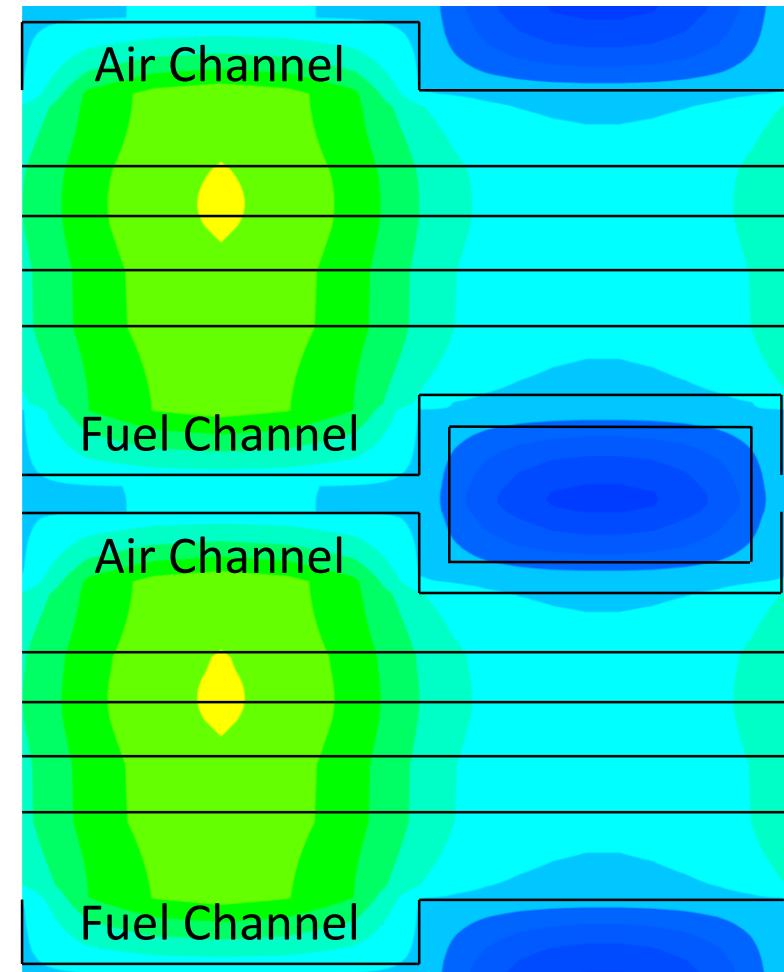


Temperature profile (375A)

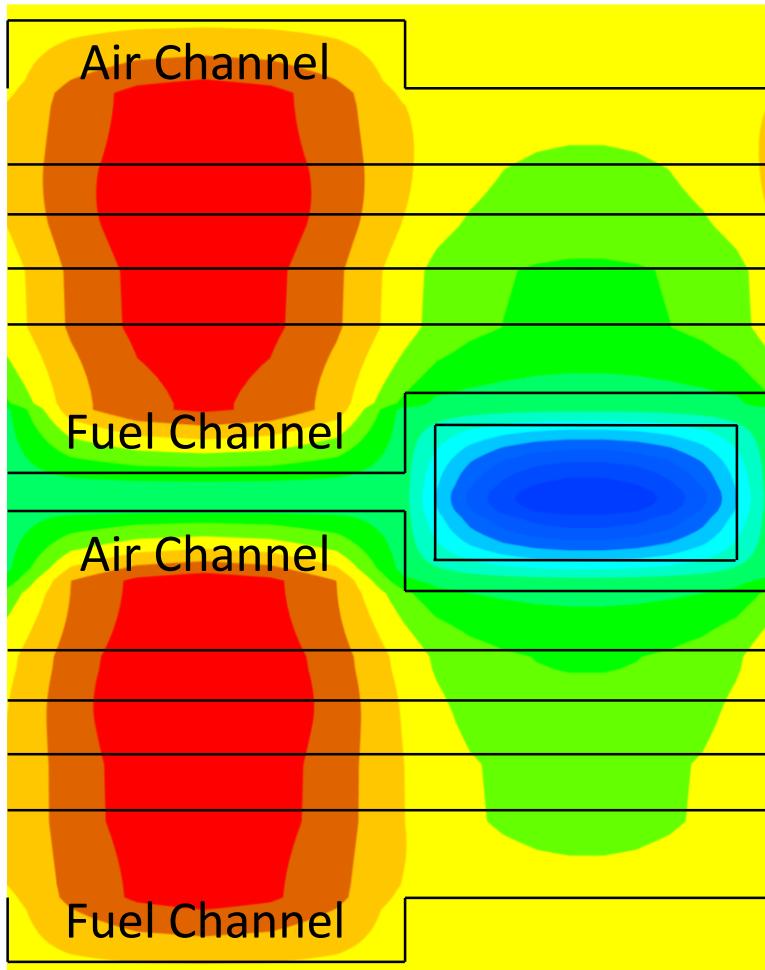


Temperature (K)

- 354.25-354.9
- 353.6-354.25
- 352.95-353.6
- 352.3-352.95
- 351.65-352.3
- 351-351.65
- 350.35-351
- 349.7-350.35
- 349.05-349.7
- 348.4-349.05
- 347.75-348.4
- 347.1-347.75
- 346.45-347.1
- 345.8-346.45
- 345.15-345.8
- 344.5-345.15
- 343.85-344.5
- 343.2-343.85

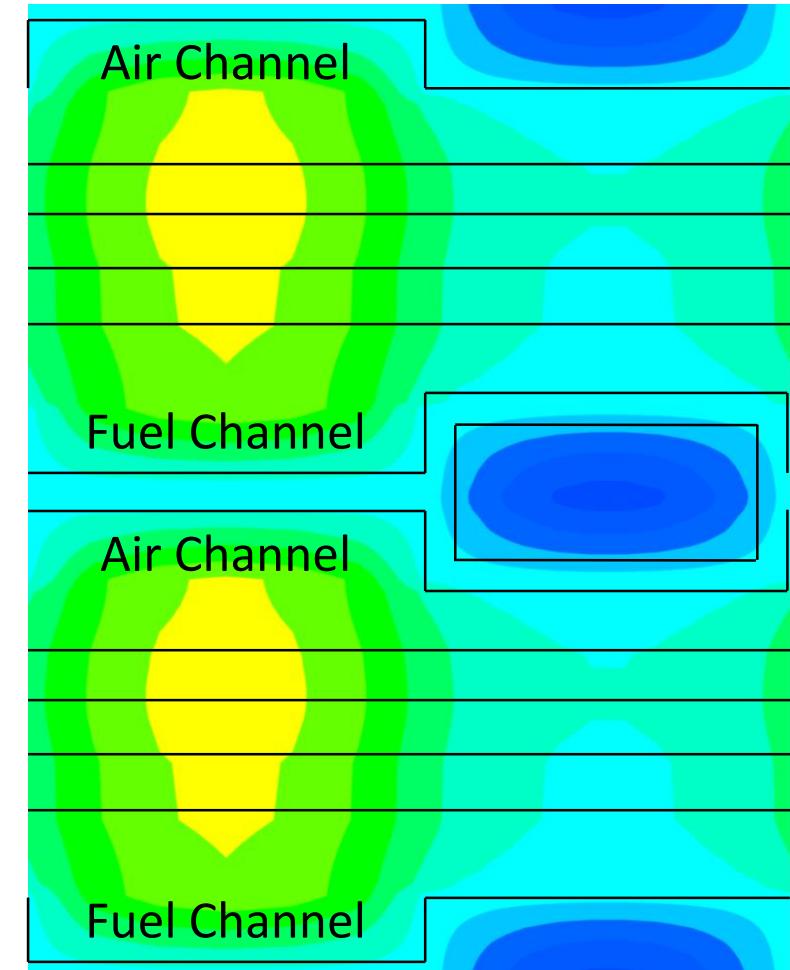


Temperature profile (375A)

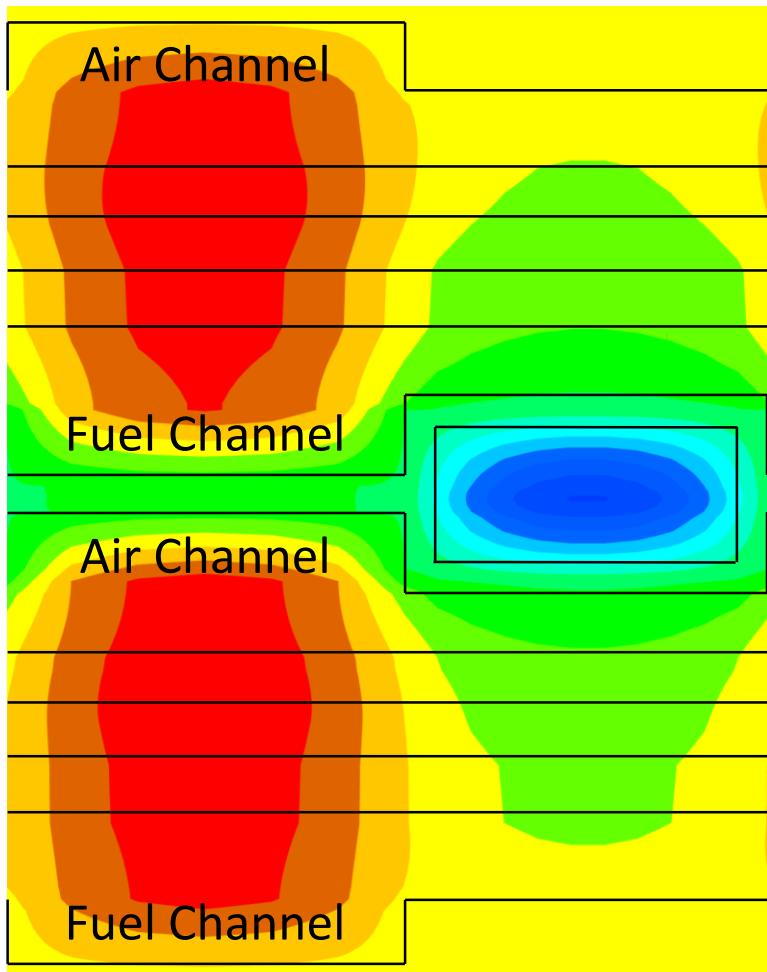
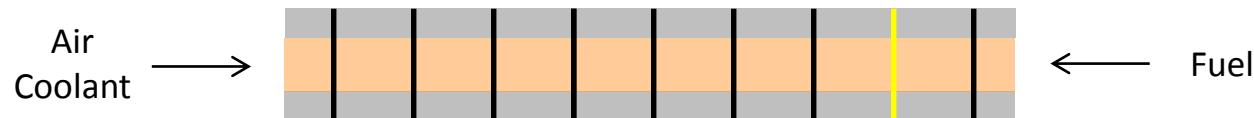


Temperature (K)

- 354.25-354.9
- 353.6-354.25
- 352.95-353.6
- 352.3-352.95
- 351.65-352.3
- 351-351.65
- 350.35-351
- 349.7-350.35
- 349.05-349.7
- 348.4-349.05
- 347.75-348.4
- 347.1-347.75
- 346.45-347.1
- 345.8-346.45
- 345.15-345.8
- 344.5-345.15
- 343.85-344.5
- 343.2-343.85

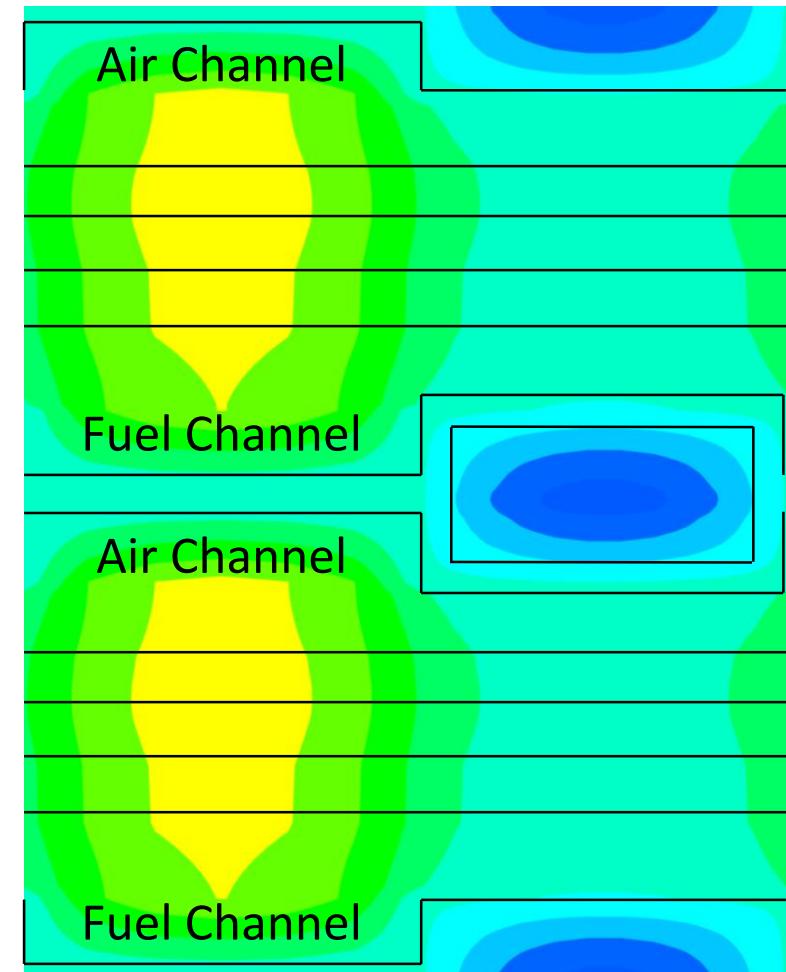


Temperature profile (375A)

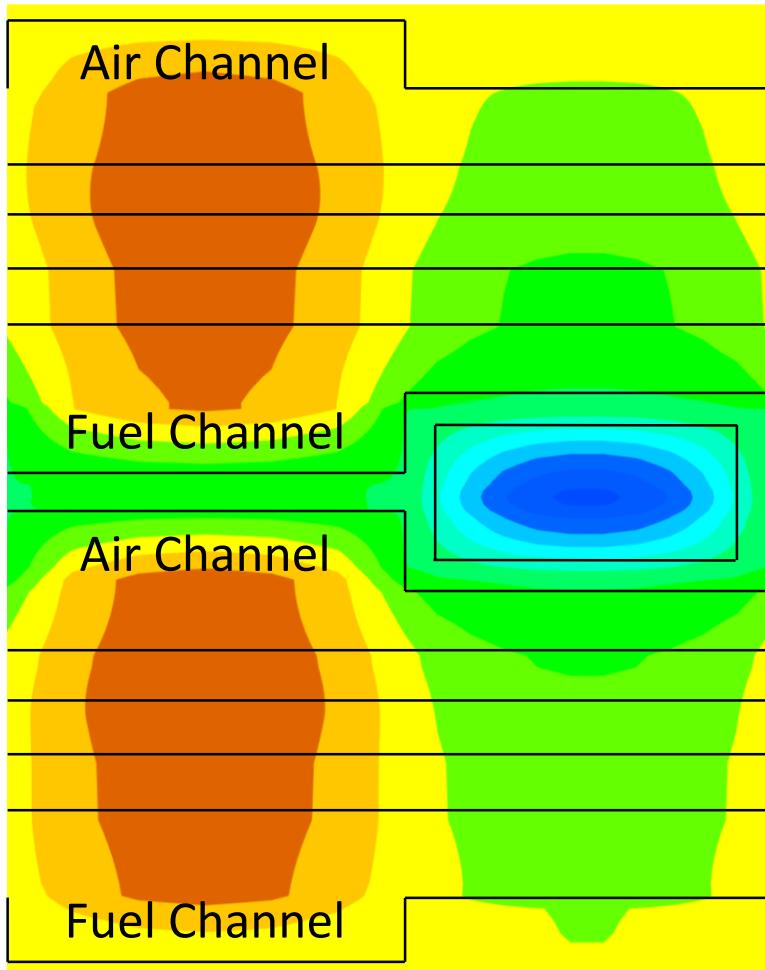
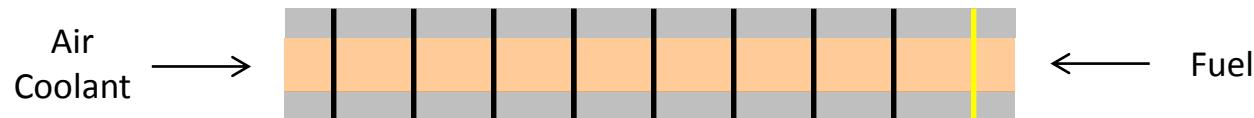


Temperature (K)

- 354.25-354.9
- 353.6-354.25
- 352.95-353.6
- 352.3-352.95
- 351.65-352.3
- 351-351.65
- 350.35-351
- 349.7-350.35
- 349.05-349.7
- 348.4-349.05
- 347.75-348.4
- 347.1-347.75
- 346.45-347.1
- 345.8-346.45
- 345.15-345.8
- 344.5-345.15
- 343.85-344.5
- 343.2-343.85

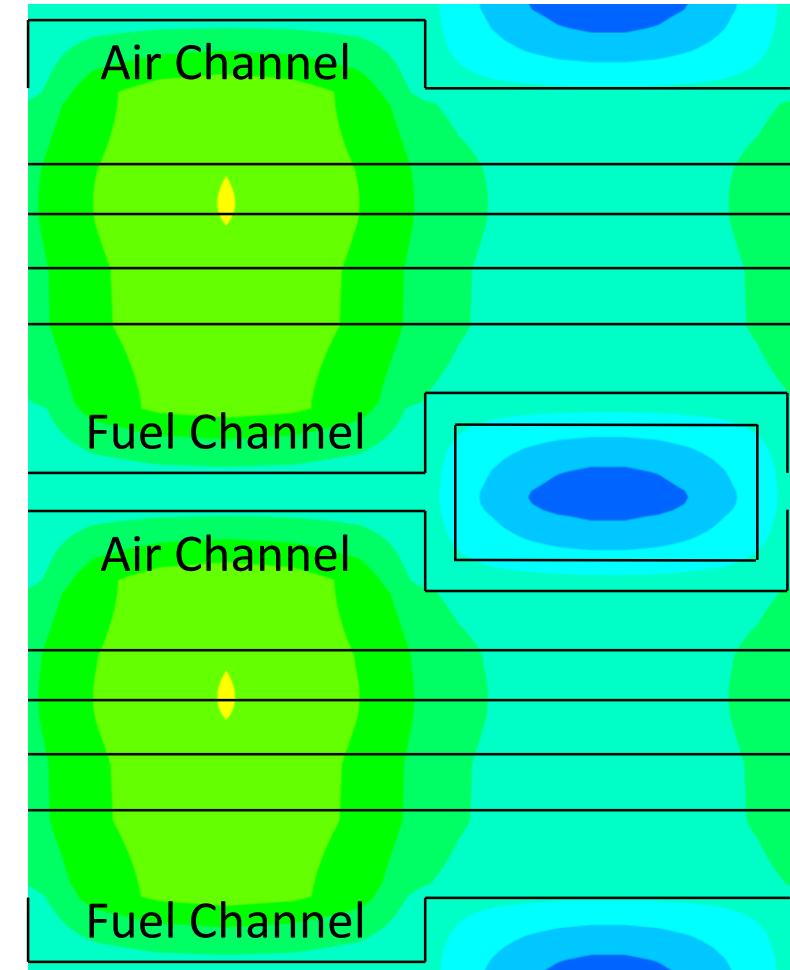


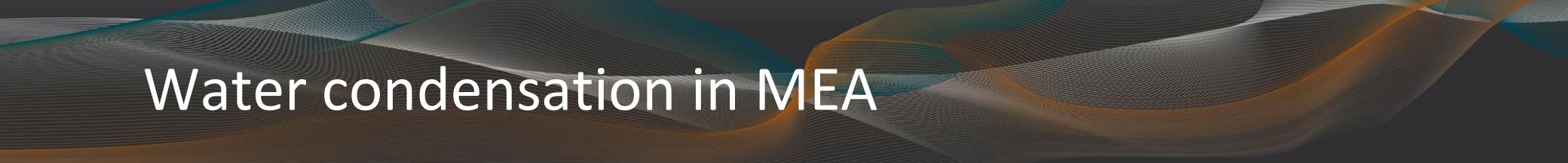
Temperature profile (375A)



Temperature (K)

- 354.25-354.9
- 353.6-354.25
- 352.95-353.6
- 352.3-352.95
- 351.65-352.3
- 351-351.65
- 350.35-351
- 349.7-350.35
- 349.05-349.7
- 348.4-349.05
- 347.75-348.4
- 347.1-347.75
- 346.45-347.1
- 345.8-346.45
- 345.15-345.8
- 344.5-345.15
- 343.85-344.5
- 343.2-343.85

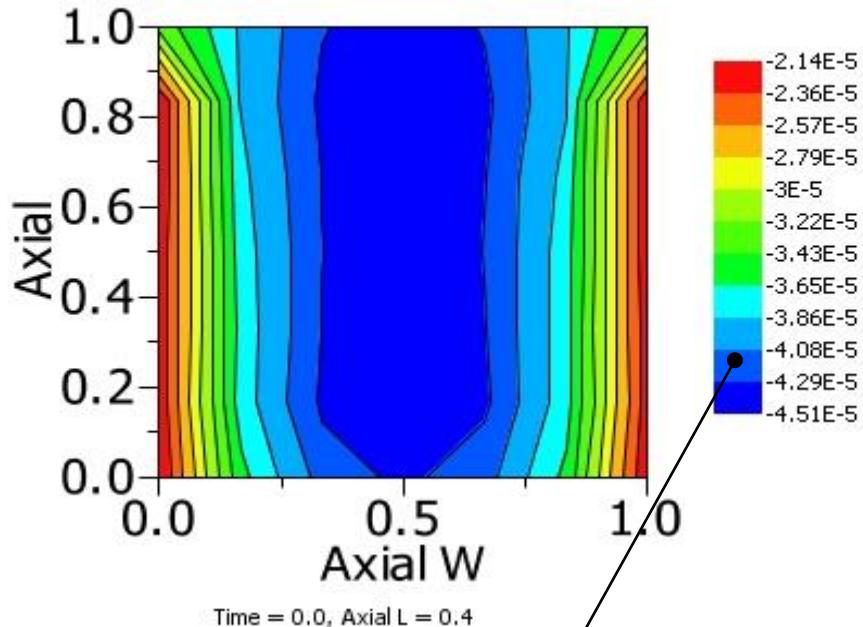




Water condensation in MEA

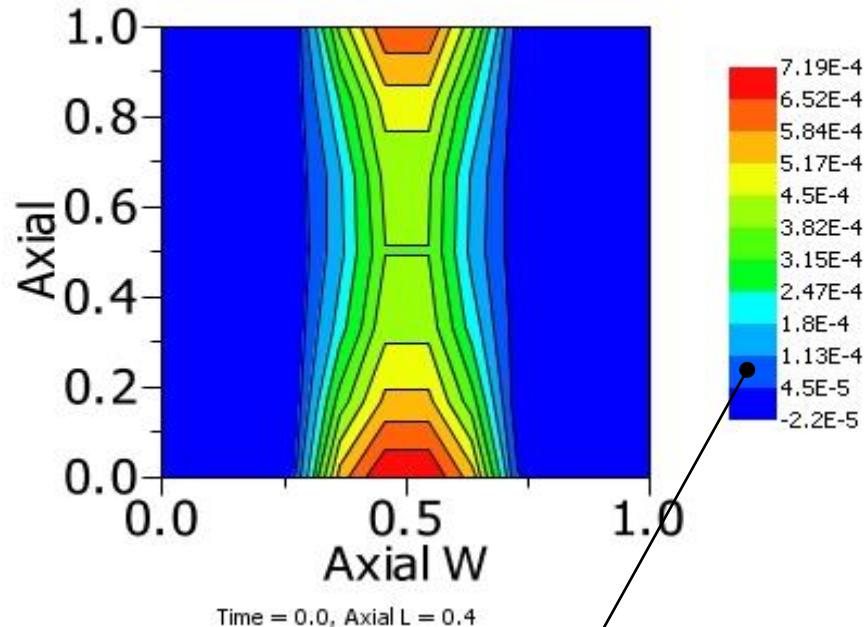
Water internal condensation/vaporisation cycle

STACK_SYS.Stack.Membrane.CATHODE_Side_A.M_Water_to_liquid



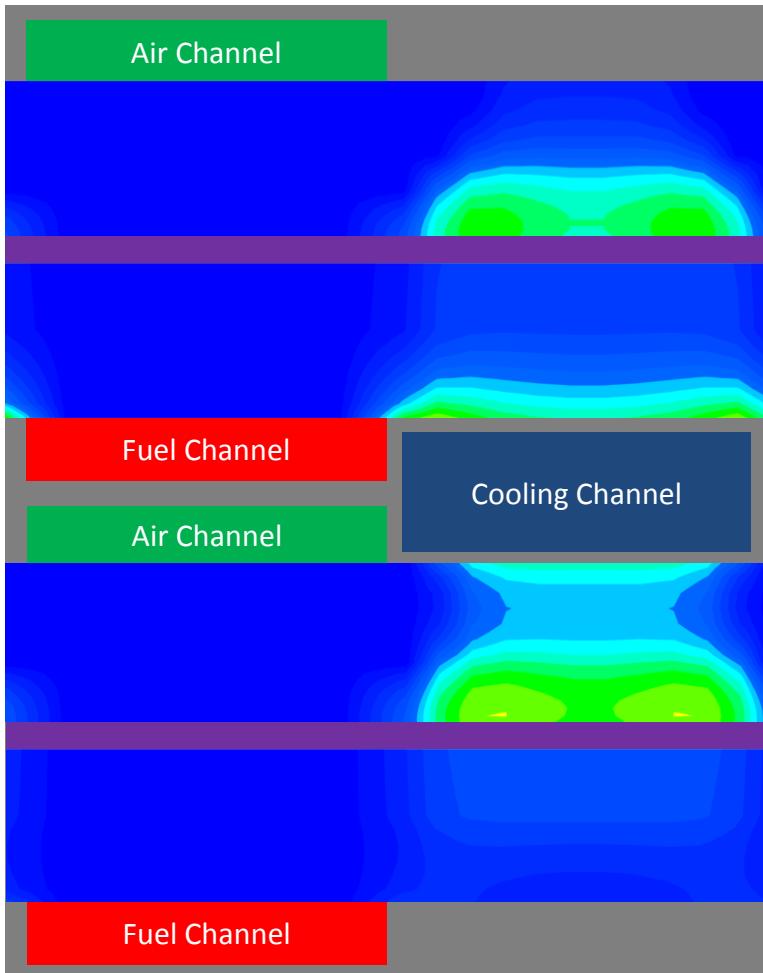
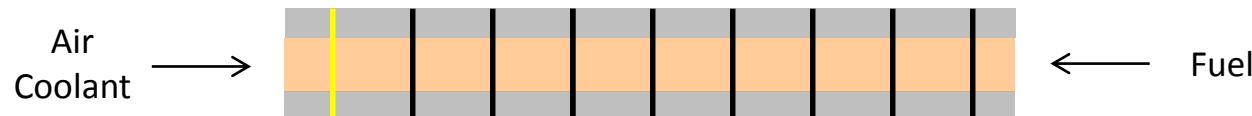
Water vaporisation in GDL area
over Air channel

STACK_SYS.Stack.Membrane.CATHODE_Side_B.M_Water_to_liquid



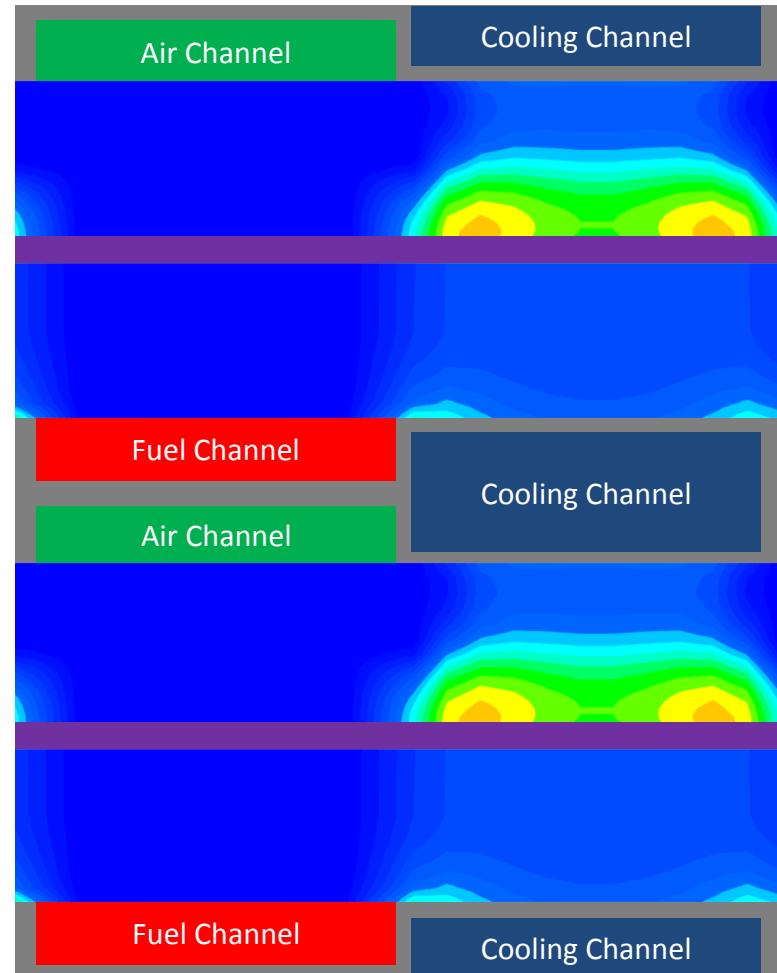
Water condensation in the
middle of GDL area over land

Water condensation profile (375A)

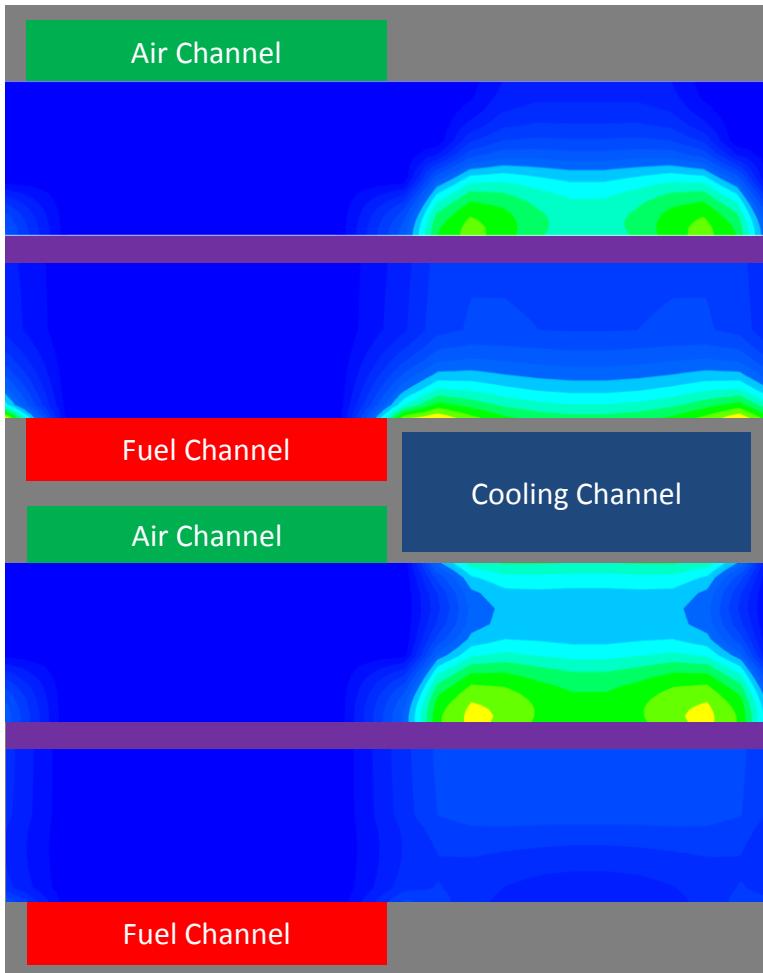


Water
Condensation
($\text{g/m}^3\text{s}$)

- ◻ 0.00401-0.00428
- ◻ 0.00374-0.00401
- ◻ 0.00347-0.00374
- ◻ 0.0032-0.00347
- ◻ 0.00293-0.0032
- ◻ 0.00266-0.00293
- ◻ 0.00239-0.00266
- ◻ 0.00212-0.00239
- ◻ 0.00185-0.00212
- ◻ 0.00158-0.00185
- ◻ 0.00131-0.00158
- ◻ 0.00104-0.00131
- ◻ 0.00077-0.00104
- ◻ 0.0005-0.00077
- ◻ 0.00023-0.0005
- ◻ -4E-05-0.00023

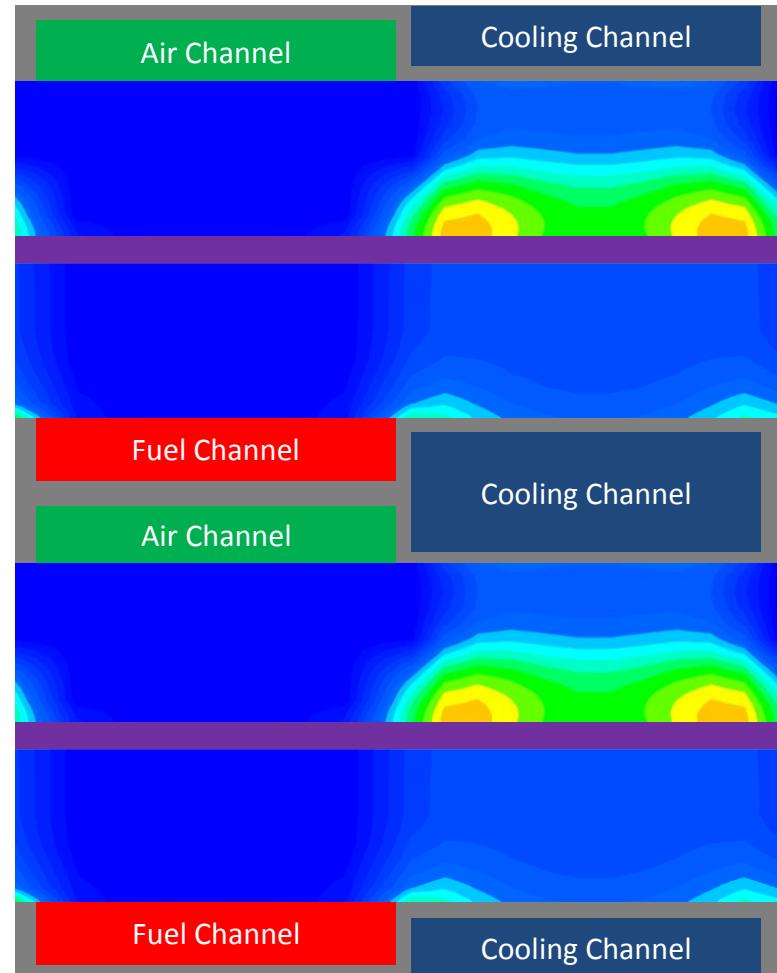


Water condensation profile (375A)

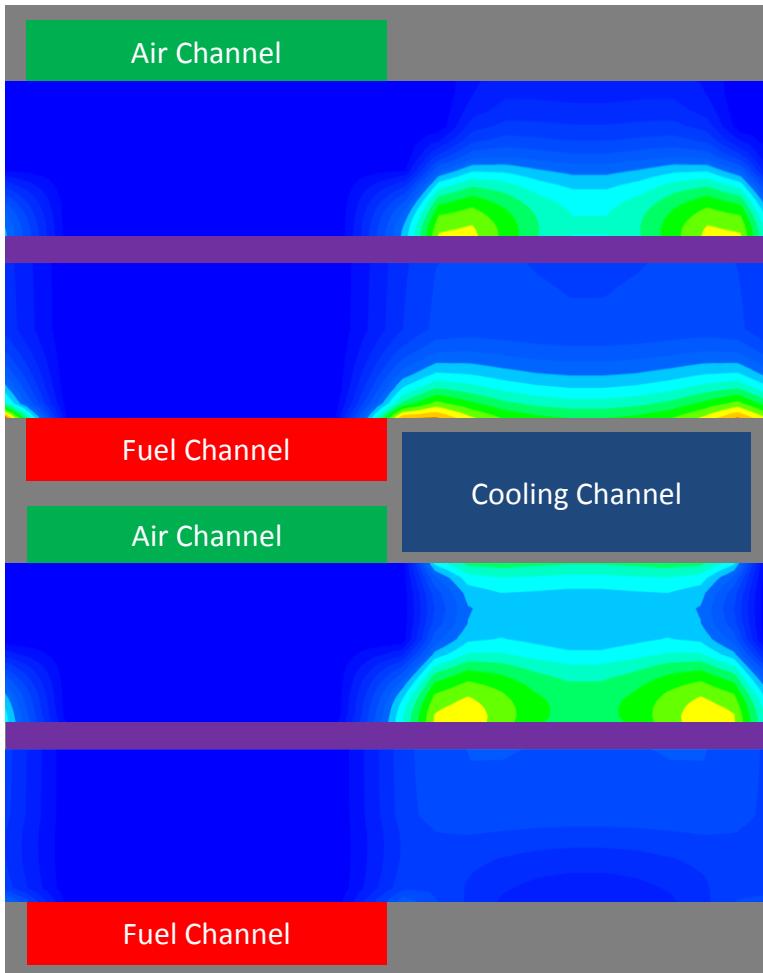
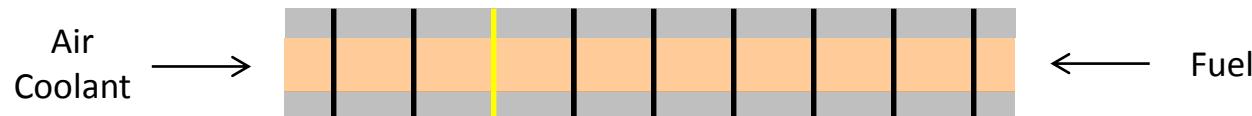


Water Condensation ($\text{g/m}^3\text{s}$)

- 0.00401-0.00428
- 0.00374-0.00401
- 0.00347-0.00374
- 0.0032-0.00347
- 0.00293-0.0032
- 0.00266-0.00293
- 0.00239-0.00266
- 0.00212-0.00239
- 0.00185-0.00212
- 0.00158-0.00185
- 0.00131-0.00158
- 0.00104-0.00131
- 0.00077-0.00104
- 0.0005-0.00077
- 0.00023-0.0005
- -4E-05-0.00023

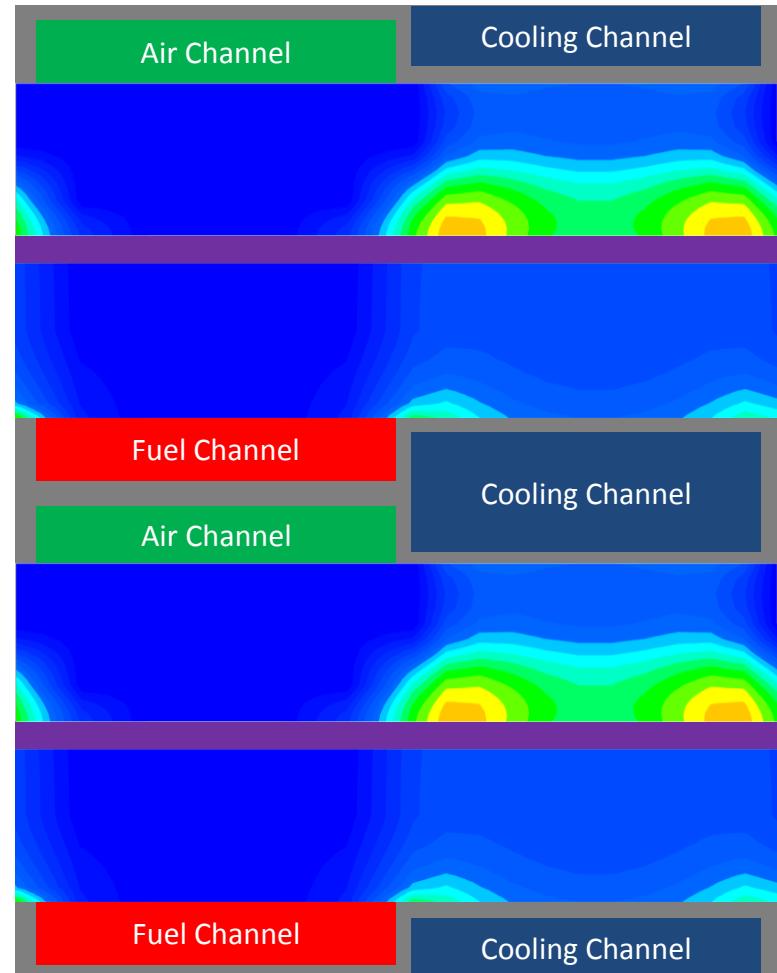


Water condensation profile (375A)

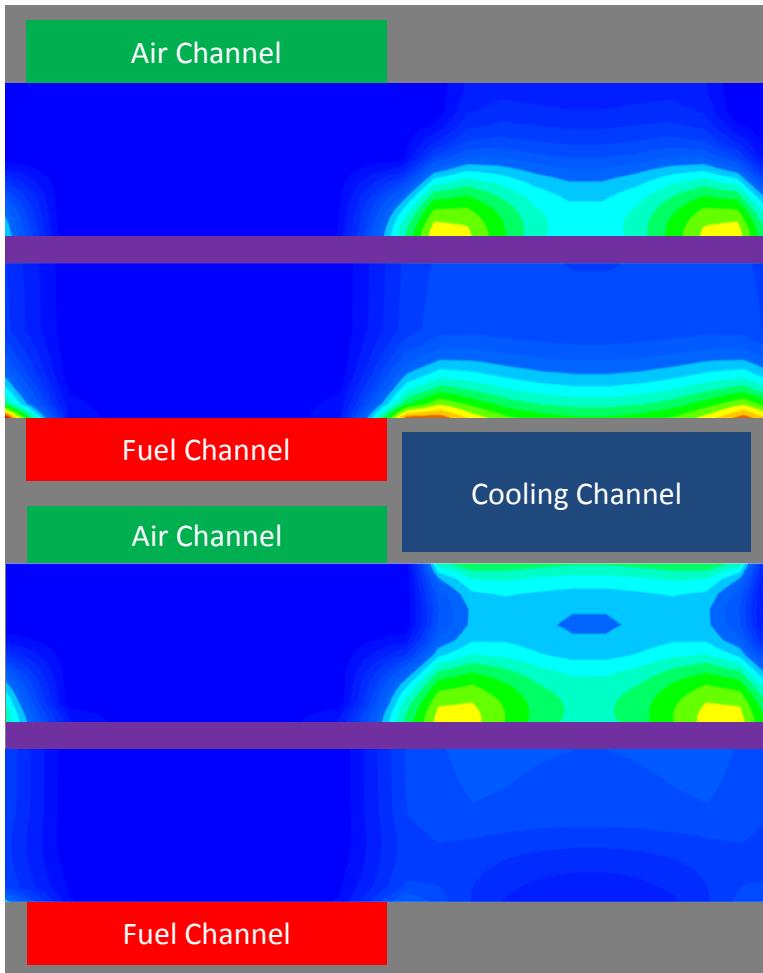


Water
Condensation
($\text{g/m}^3\text{s}$)

- ◻ 0.00401-0.00428
- ◻ 0.00374-0.00401
- ◻ 0.00347-0.00374
- ◻ 0.0032-0.00347
- ◻ 0.00293-0.0032
- ◻ 0.00266-0.00293
- ◻ 0.00239-0.00266
- ◻ 0.00212-0.00239
- ◻ 0.00185-0.00212
- ◻ 0.00158-0.00185
- ◻ 0.00131-0.00158
- ◻ 0.00104-0.00131
- ◻ 0.00077-0.00104
- ◻ 0.0005-0.00077
- ◻ 0.00023-0.0005
- ◻ -4E-05-0.00023

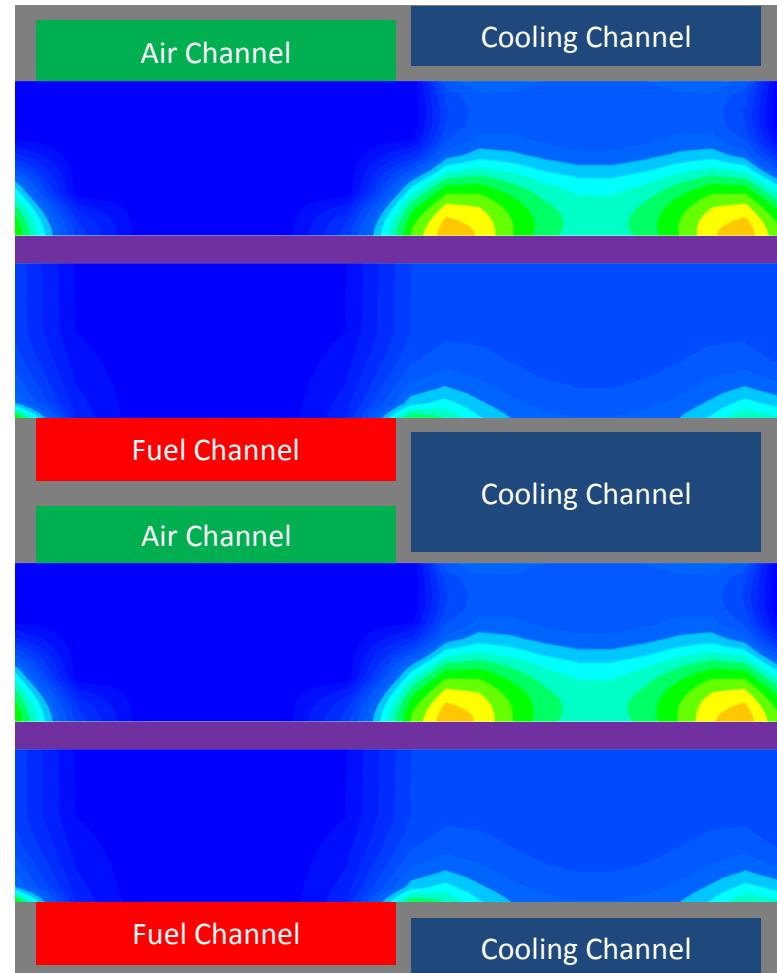


Water condensation profile (375A)

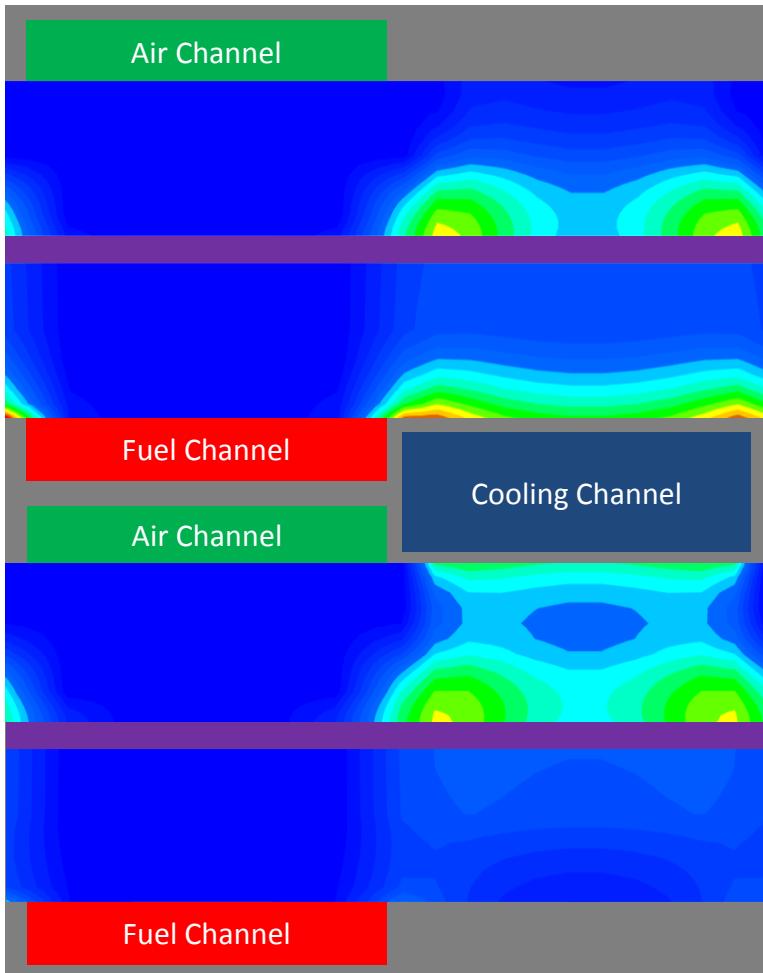


Water Condensation ($\text{g/m}^3\text{s}$)

- ◻ 0.00401-0.00428
- ◻ 0.00374-0.00401
- ◻ 0.00347-0.00374
- ◻ 0.0032-0.00347
- ◻ 0.00293-0.0032
- ◻ 0.00266-0.00293
- ◻ 0.00239-0.00266
- ◻ 0.00212-0.00239
- ◻ 0.00185-0.00212
- ◻ 0.00158-0.00185
- ◻ 0.00131-0.00158
- ◻ 0.00104-0.00131
- ◻ 0.00077-0.00104
- ◻ 0.0005-0.00077
- ◻ 0.00023-0.0005
- ◻ -4E-05-0.00023

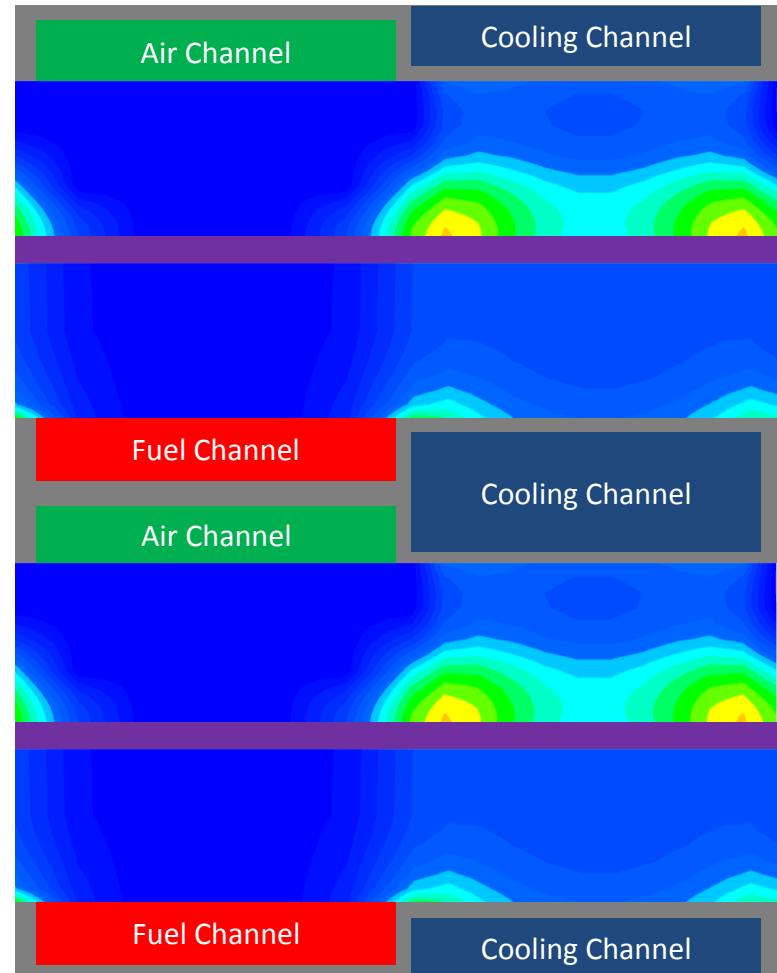


Water condensation profile (375A)

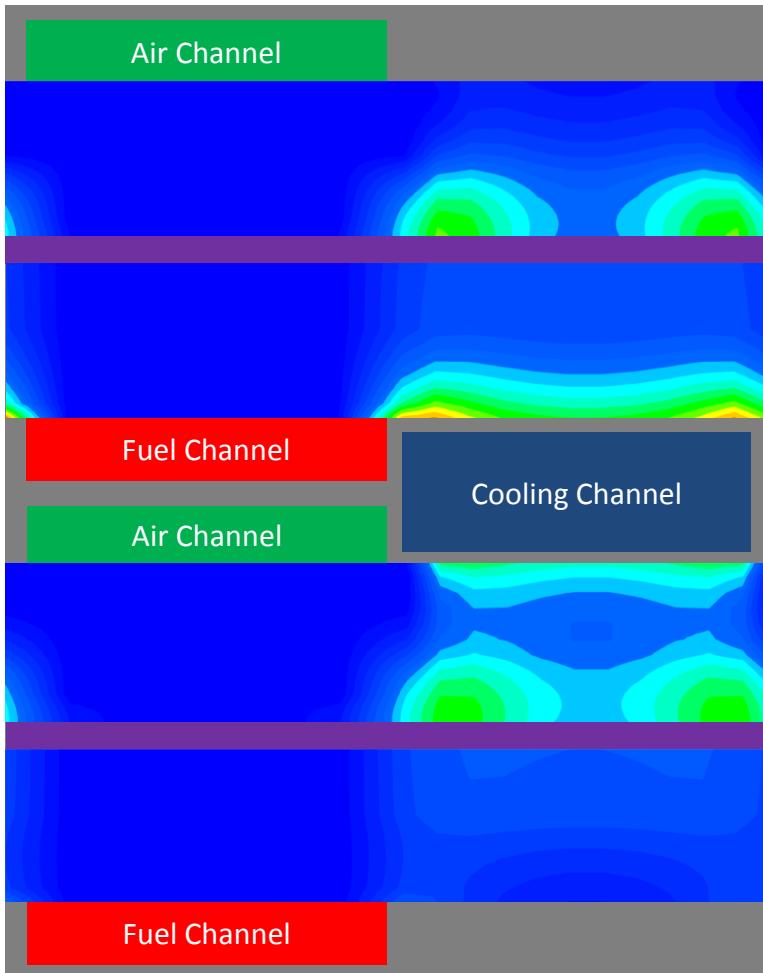
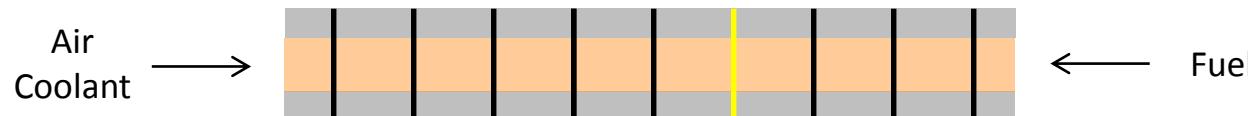


Water
Condensation
($\text{g/m}^3\text{s}$)

- 0.00401-0.00428
- 0.00374-0.00401
- 0.00347-0.00374
- 0.0032-0.00347
- 0.00293-0.0032
- 0.00266-0.00293
- 0.00239-0.00266
- 0.00212-0.00239
- 0.00185-0.00212
- 0.00158-0.00185
- 0.00131-0.00158
- 0.00104-0.00131
- 0.00077-0.00104
- 0.0005-0.00077
- 0.00023-0.0005
- -4E-05-0.00023

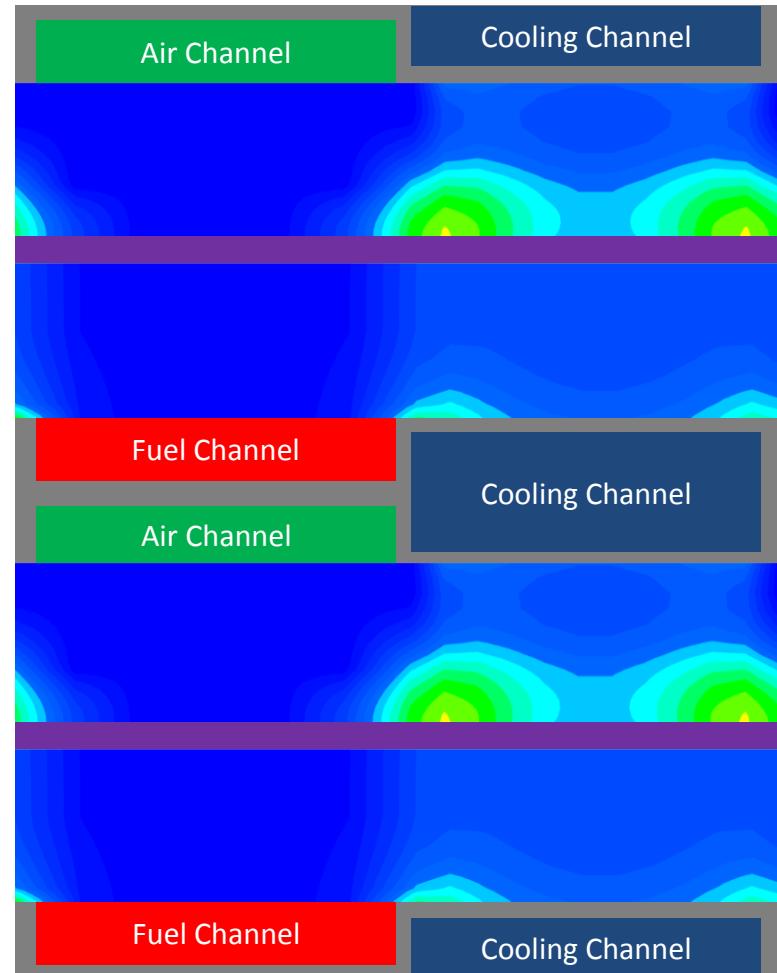


Water condensation profile (375A)

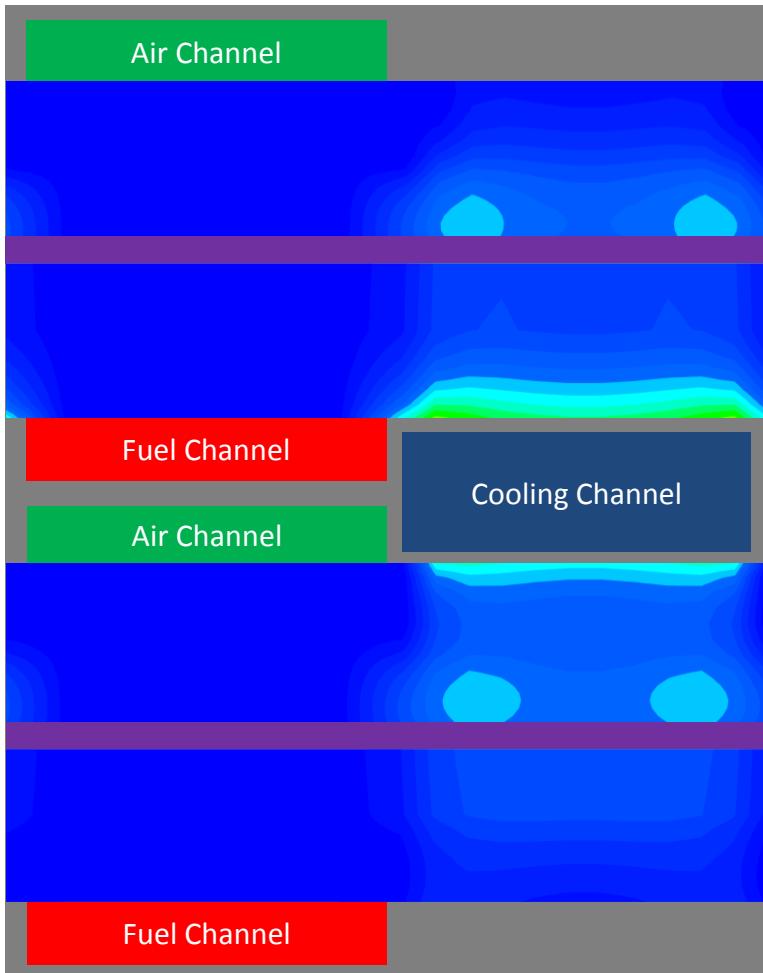


Water Condensation
($\text{g/m}^3\text{s}$)

- ☐ 0.00401-0.00428
- ☐ 0.00374-0.00401
- ☒ 0.00347-0.00374
- ☒ 0.0032-0.00347
- ☒ 0.00293-0.0032
- ☒ 0.00266-0.00293
- ☒ 0.00239-0.00266
- ☒ 0.00212-0.00239
- ☒ 0.00185-0.00212
- ☒ 0.00158-0.00185
- ☒ 0.00131-0.00158
- ☒ 0.00104-0.00131
- ☒ 0.00077-0.00104
- ☒ 0.0005-0.00077
- ☒ 0.00023-0.0005
- ☒ -4E-05-0.00023

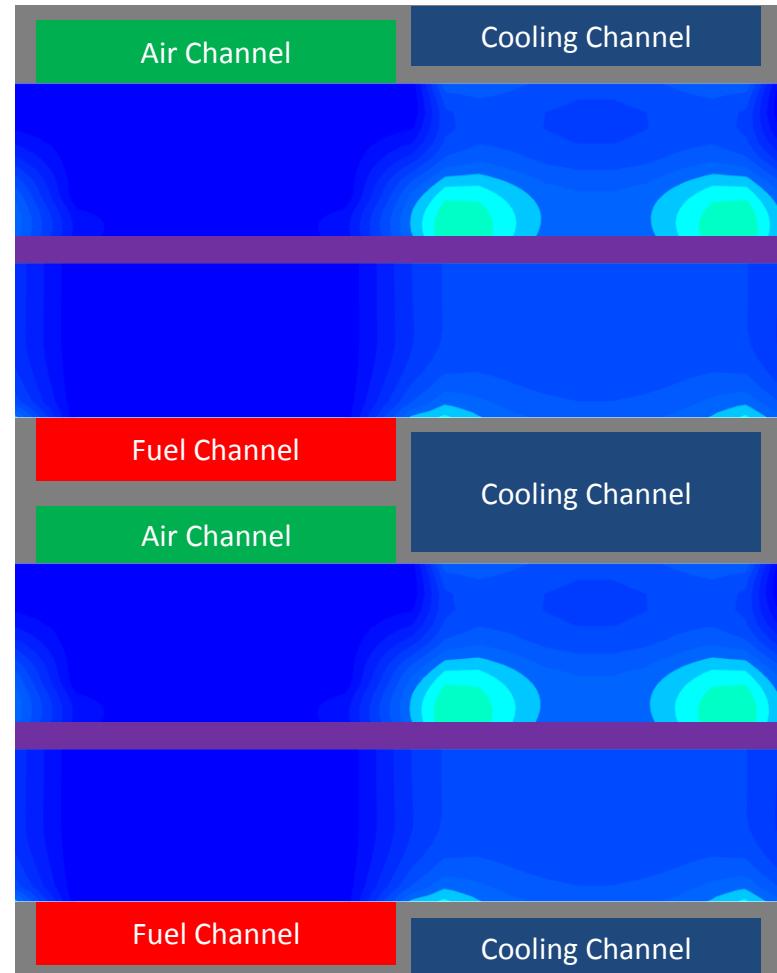


Water condensation profile (375A)

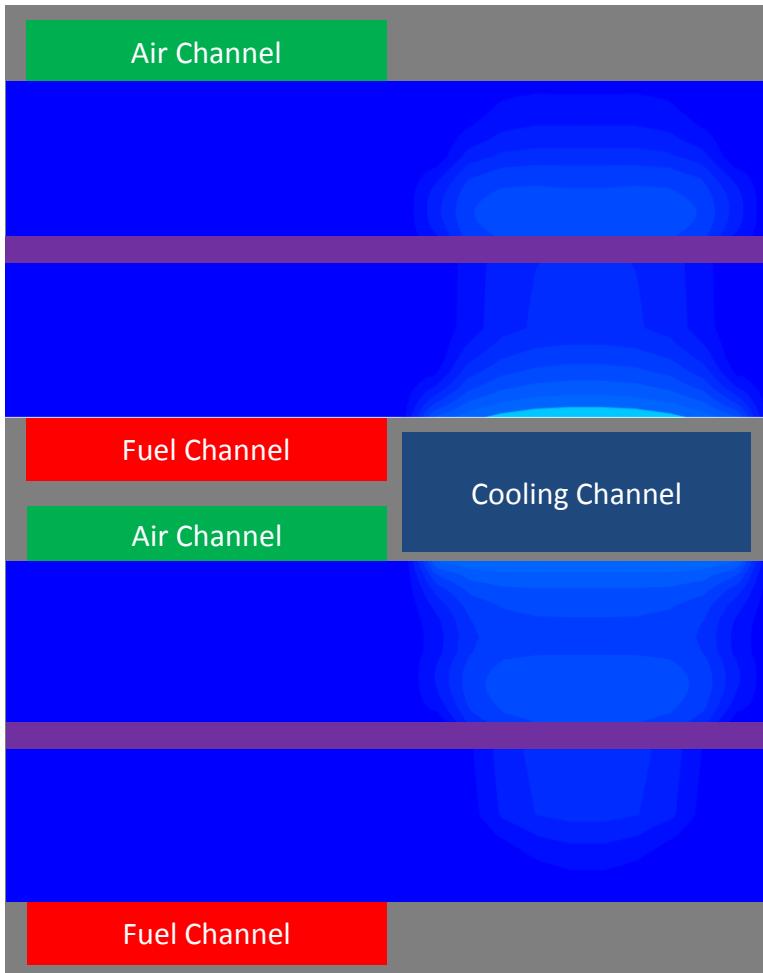


Water Condensation ($\text{g/m}^3\text{s}$)

- ☐ 0.00401-0.00428
- ☐ 0.00374-0.00401
- ☒ 0.00347-0.00374
- ☒ 0.0032-0.00347
- ☒ 0.00293-0.0032
- ☒ 0.00266-0.00293
- ☒ 0.00239-0.00266
- ☒ 0.00212-0.00239
- ☒ 0.00185-0.00212
- ☒ 0.00158-0.00185
- ☒ 0.00131-0.00158
- ☒ 0.00104-0.00131
- ☒ 0.00077-0.00104
- ☒ 0.0005-0.00077
- ☒ 0.00023-0.0005
- ☒ -4E-05-0.00023

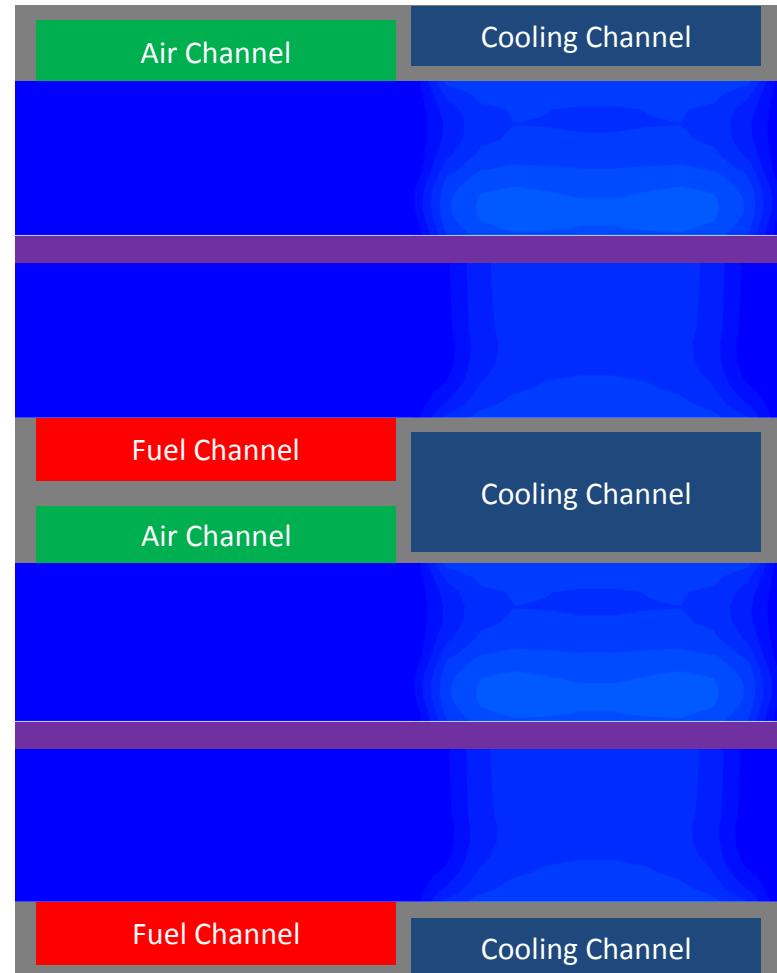


Water condensation profile (375A)

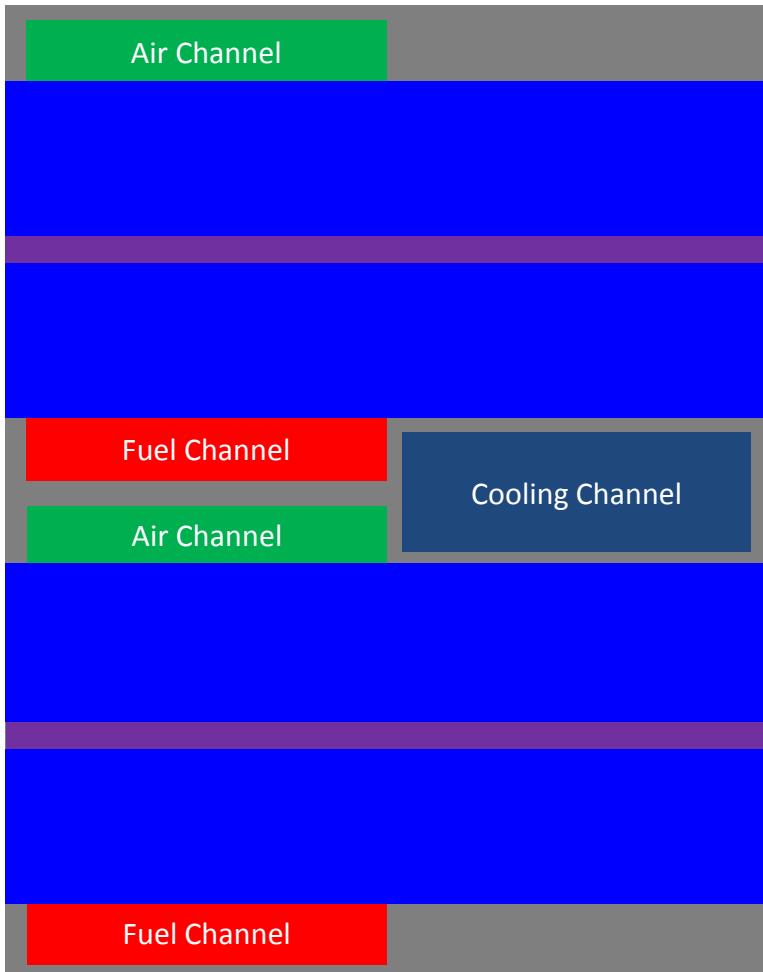


Water Condensation ($\text{g/m}^3\text{s}$)

- 0.00401-0.00428
- 0.00374-0.00401
- 0.00347-0.00374
- 0.0032-0.00347
- 0.00293-0.0032
- 0.00266-0.00293
- 0.00239-0.00266
- 0.00212-0.00239
- 0.00185-0.00212
- 0.00158-0.00185
- 0.00131-0.00158
- 0.00104-0.00131
- 0.00077-0.00104
- 0.0005-0.00077
- 0.00023-0.0005
- 4E-05-0.00023

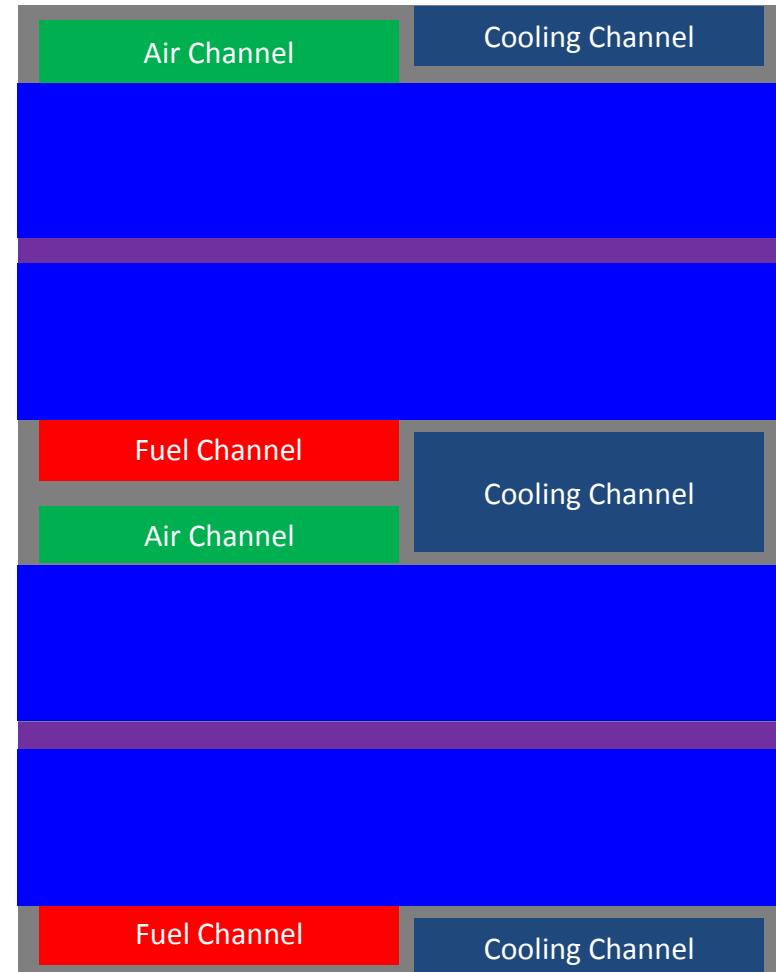


Water condensation profile (375A)



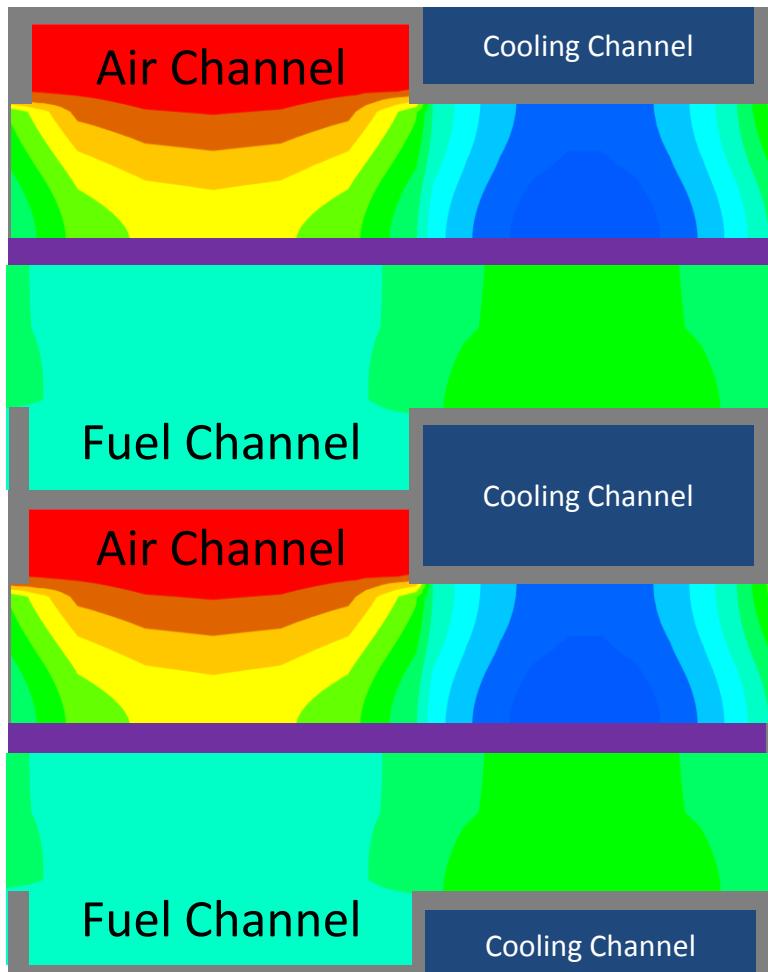
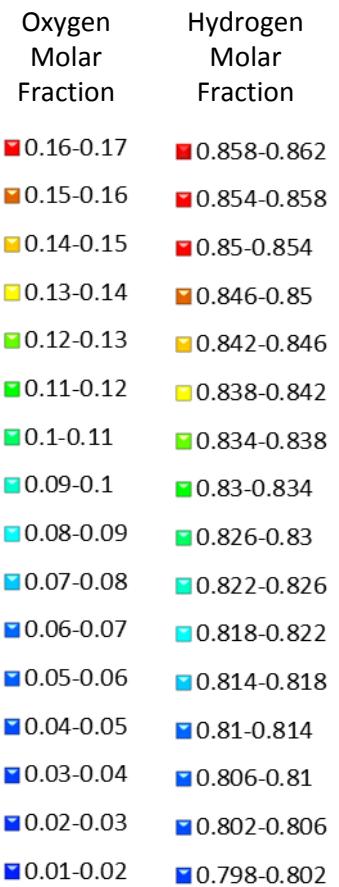
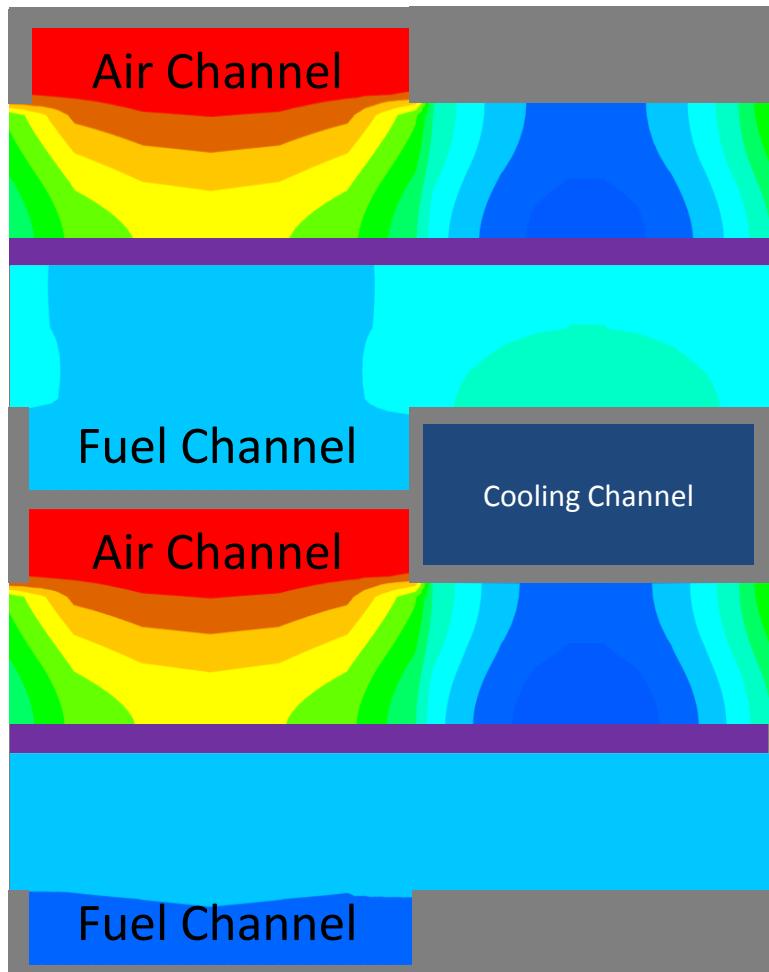
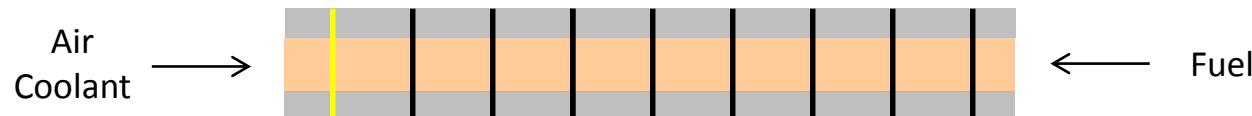
Water
Condensation
($\text{g/m}^3\text{s}$)

- 0.00401-0.00428
- 0.00374-0.00401
- 0.00347-0.00374
- 0.0032-0.00347
- 0.00293-0.0032
- 0.00266-0.00293
- 0.00239-0.00266
- 0.00212-0.00239
- 0.00185-0.00212
- 0.00158-0.00185
- 0.00131-0.00158
- 0.00104-0.00131
- 0.00077-0.00104
- 0.0005-0.00077
- 0.00023-0.0005
- 4E-05-0.00023

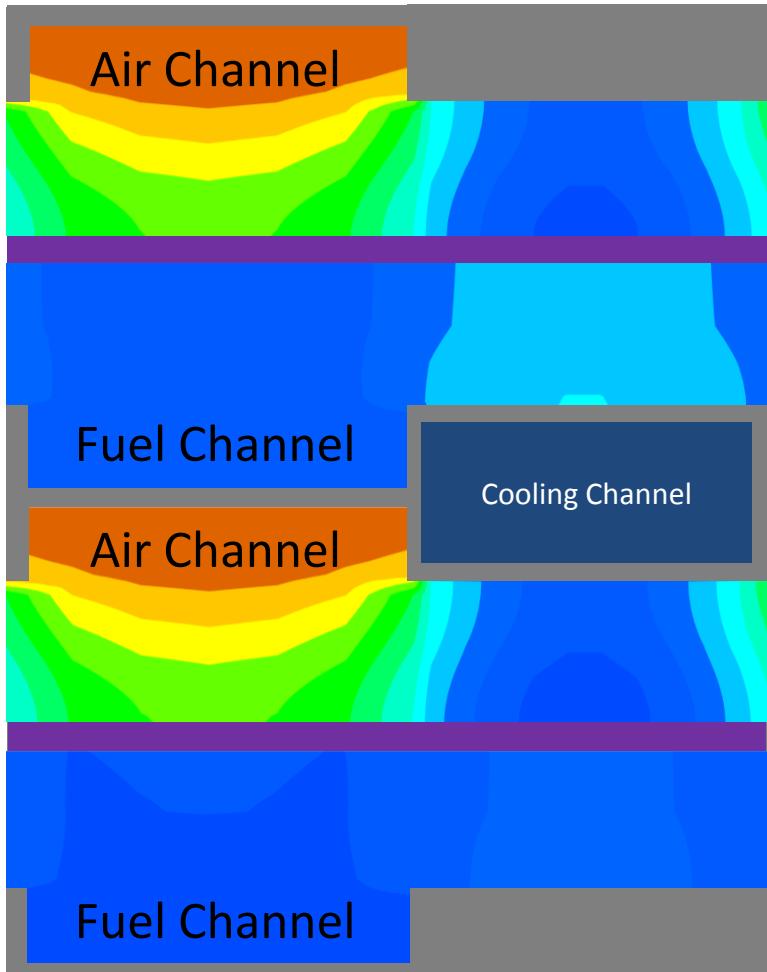
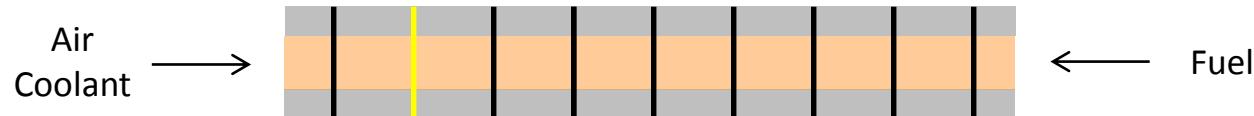


Reactants concentration in channels and MEA

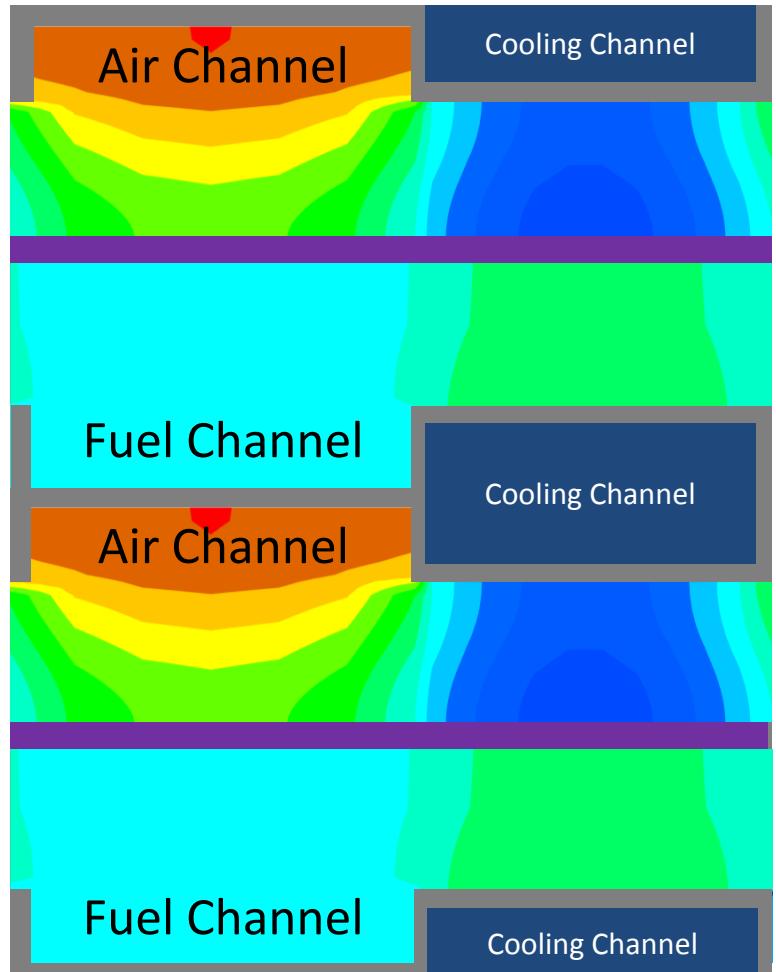
Reactant composition profiles (375A)



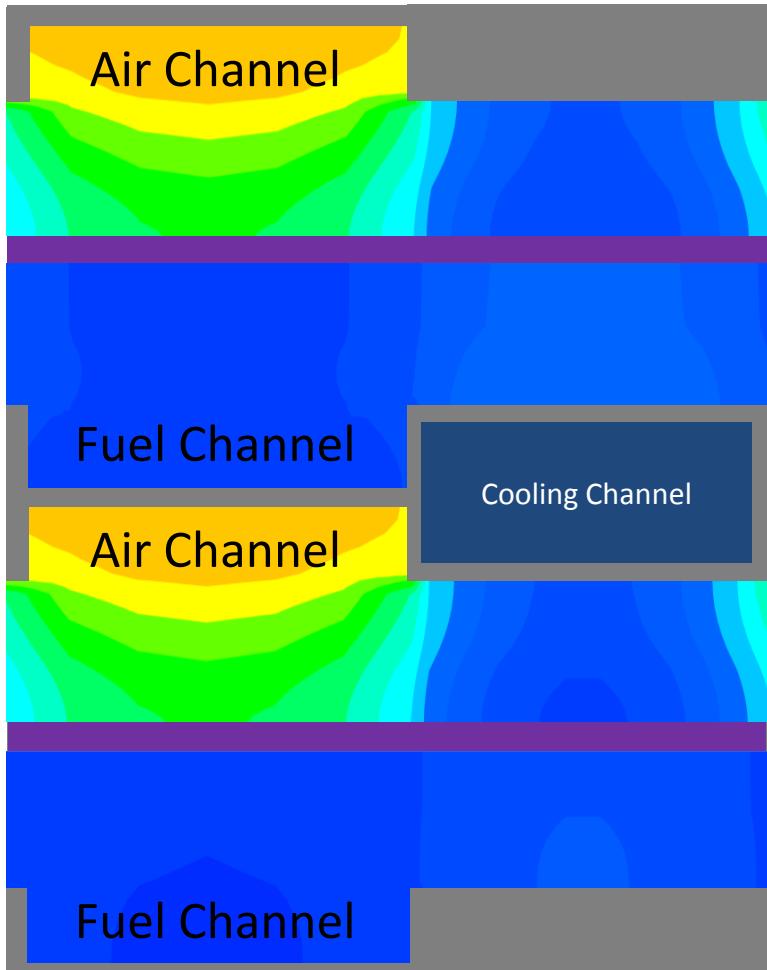
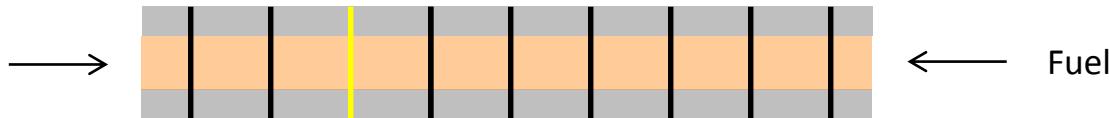
Reactant composition profiles (375A)



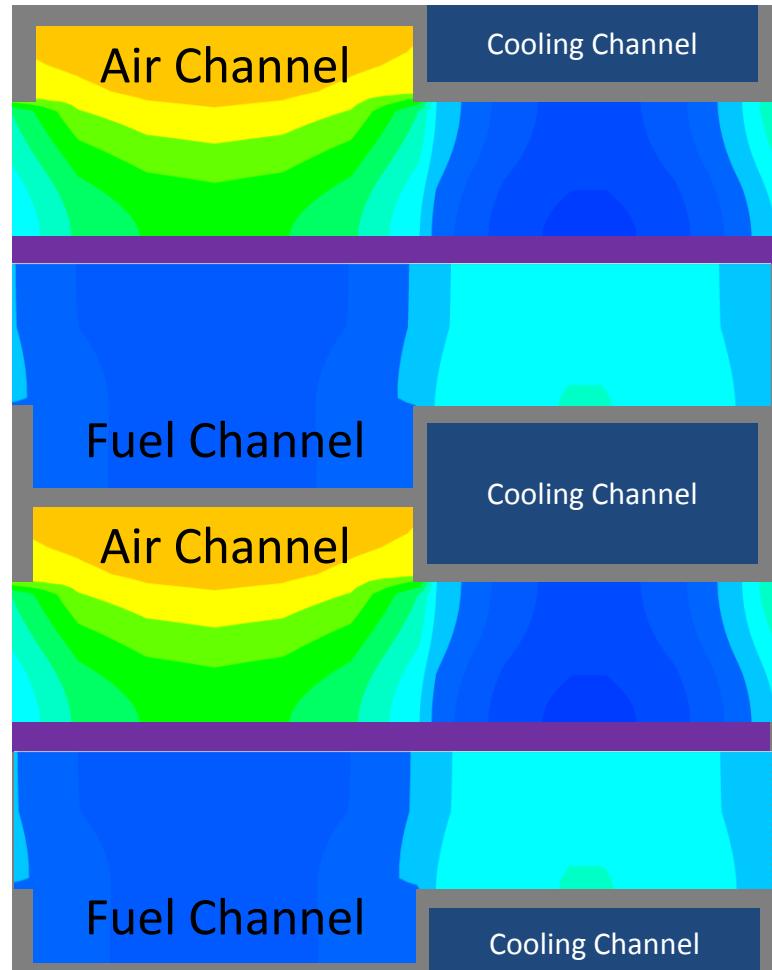
Oxygen Molar Fraction	Hydrogen Molar Fraction
0.16-0.17	0.858-0.862
0.15-0.16	0.854-0.858
0.14-0.15	0.85-0.854
0.13-0.14	0.846-0.85
0.12-0.13	0.842-0.846
0.11-0.12	0.838-0.842
0.1-0.11	0.834-0.838
0.09-0.1	0.83-0.834
0.08-0.09	0.826-0.83
0.07-0.08	0.822-0.826
0.06-0.07	0.818-0.822
0.05-0.06	0.814-0.818
0.04-0.05	0.81-0.814
0.03-0.04	0.806-0.81
0.02-0.03	0.802-0.806
0.01-0.02	0.798-0.802



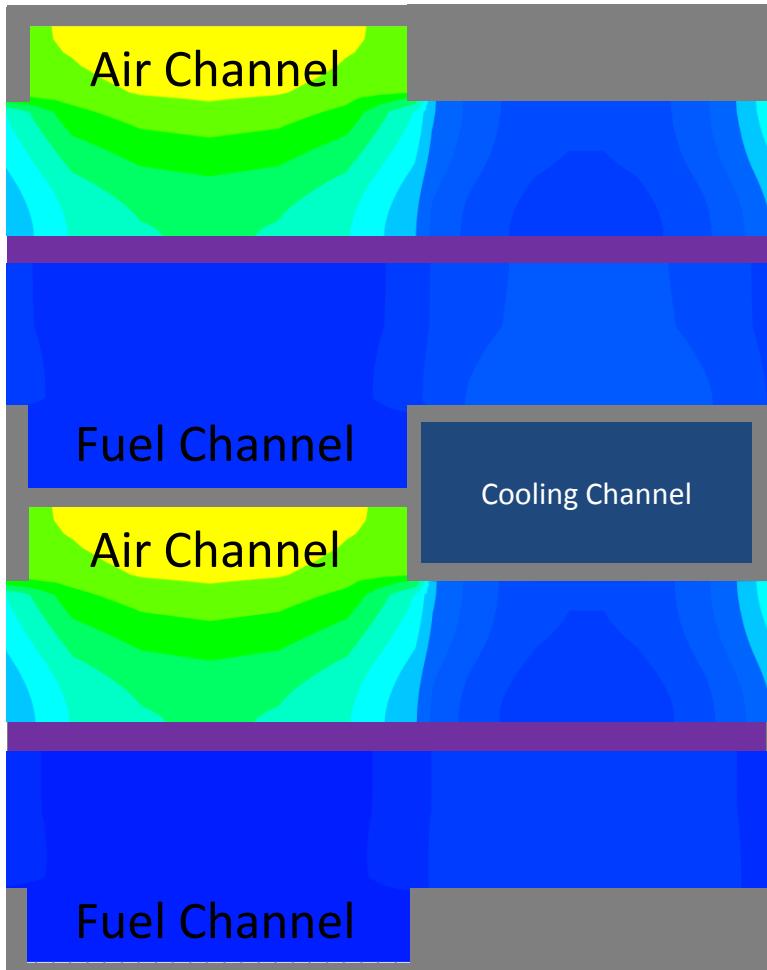
Reactant composition profiles (375A)



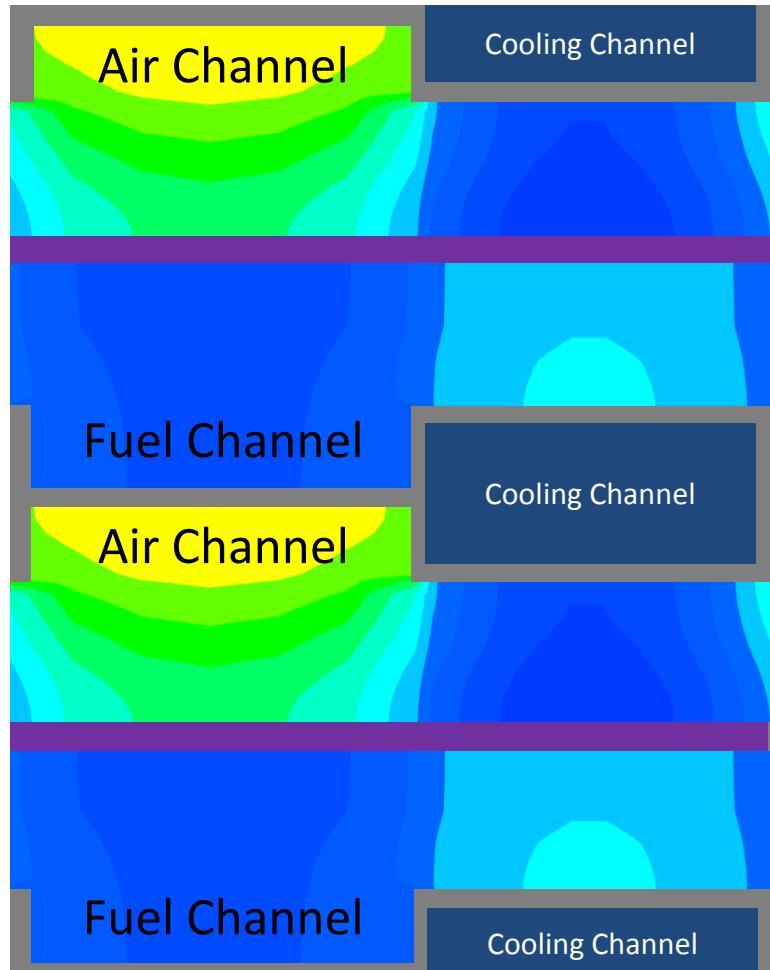
Oxygen Molar Fraction	Hydrogen Molar Fraction
0.16-0.17	0.858-0.862
0.15-0.16	0.854-0.858
0.14-0.15	0.85-0.854
0.13-0.14	0.846-0.85
0.12-0.13	0.842-0.846
0.11-0.12	0.838-0.842
0.1-0.11	0.834-0.838
0.09-0.1	0.83-0.834
0.08-0.09	0.826-0.83
0.07-0.08	0.822-0.826
0.06-0.07	0.818-0.822
0.05-0.06	0.814-0.818
0.04-0.05	0.81-0.814
0.03-0.04	0.806-0.81
0.02-0.03	0.802-0.806
0.01-0.02	0.798-0.802



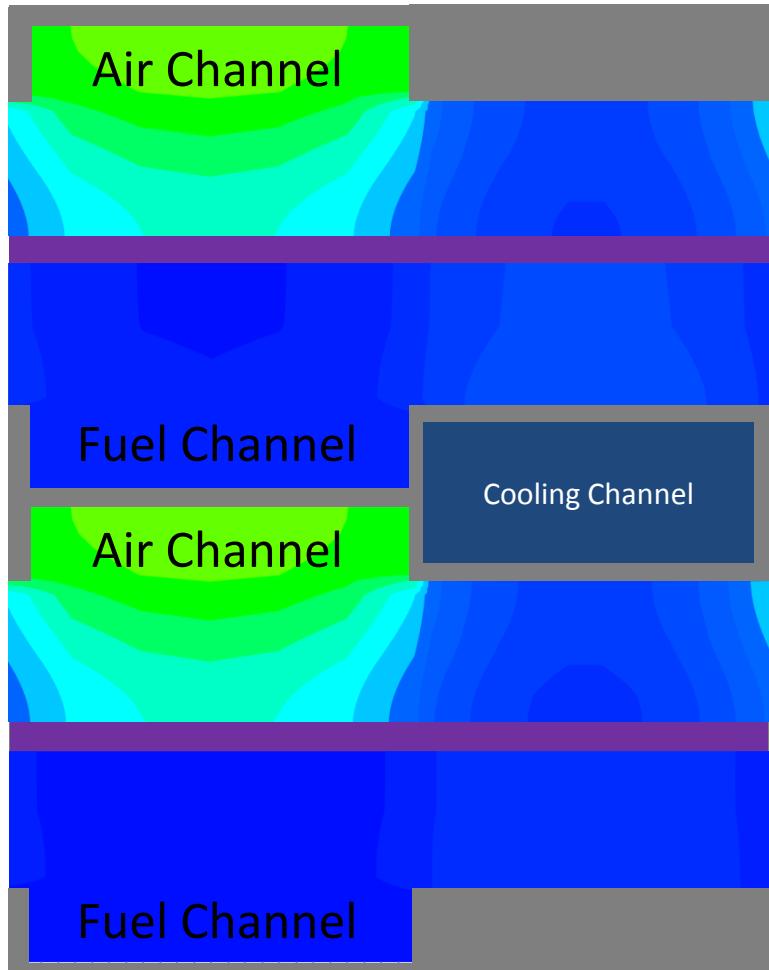
Reactant composition profiles (375A)



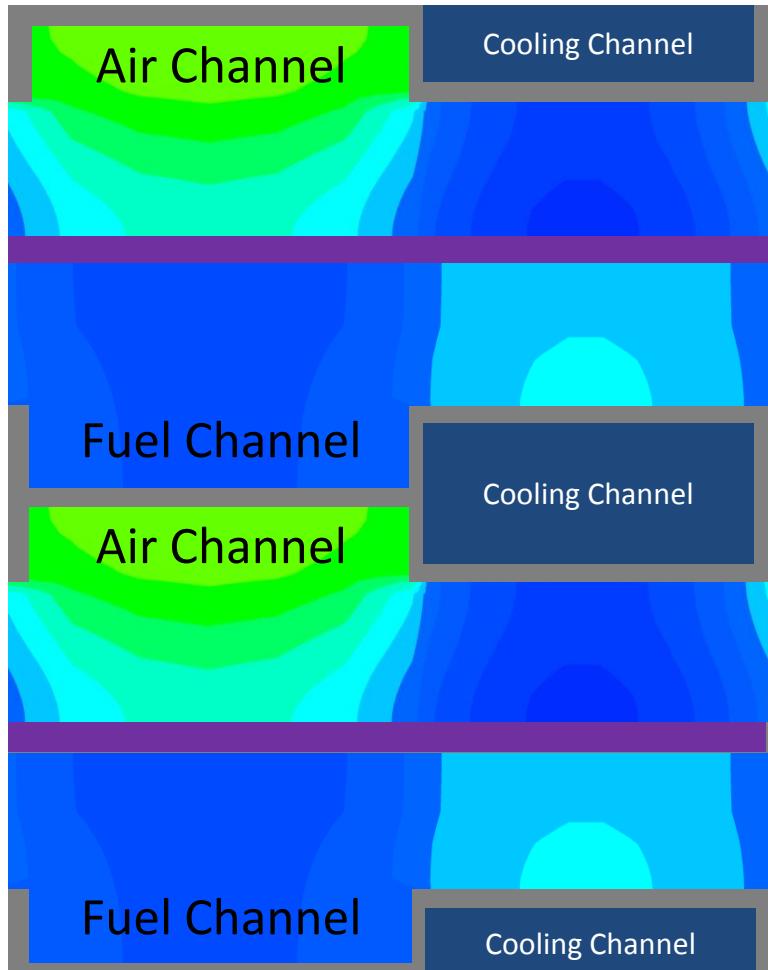
Oxygen Molar Fraction	Hydrogen Molar Fraction
0.16-0.17	0.858-0.862
0.15-0.16	0.854-0.858
0.14-0.15	0.85-0.854
0.13-0.14	0.846-0.85
0.12-0.13	0.842-0.846
0.11-0.12	0.838-0.842
0.1-0.11	0.834-0.838
0.09-0.1	0.83-0.834
0.08-0.09	0.826-0.83
0.07-0.08	0.822-0.826
0.06-0.07	0.818-0.822
0.05-0.06	0.814-0.818
0.04-0.05	0.81-0.814
0.03-0.04	0.806-0.81
0.02-0.03	0.802-0.806
0.01-0.02	0.798-0.802



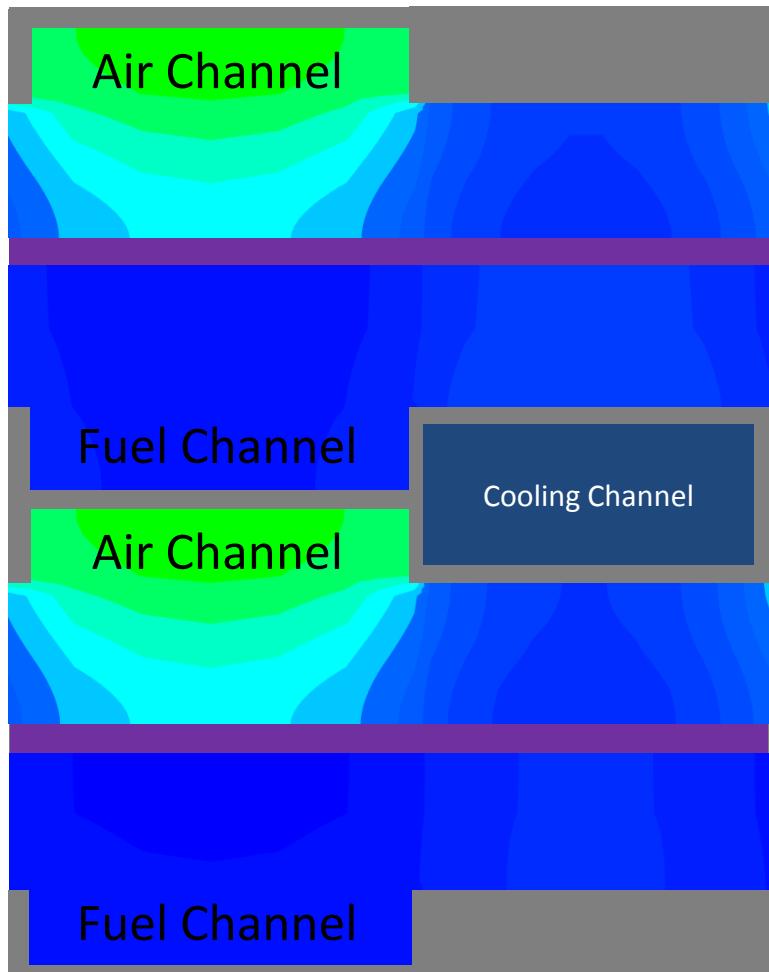
Reactant composition profiles (375A)



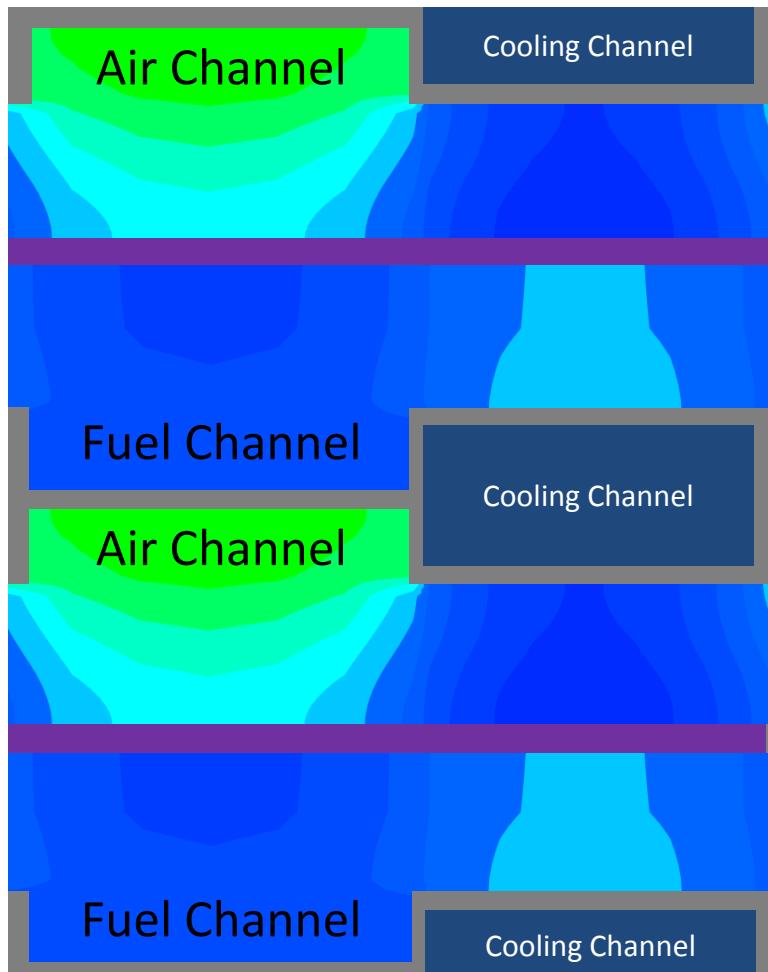
Oxygen Molar Fraction	Hydrogen Molar Fraction
0.16-0.17	0.858-0.862
0.15-0.16	0.854-0.858
0.14-0.15	0.85-0.854
0.13-0.14	0.846-0.85
0.12-0.13	0.842-0.846
0.11-0.12	0.838-0.842
0.1-0.11	0.834-0.838
0.09-0.1	0.83-0.834
0.08-0.09	0.826-0.83
0.07-0.08	0.822-0.826
0.06-0.07	0.818-0.822
0.05-0.06	0.814-0.818
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0.03-0.04	0.806-0.81
0.02-0.03	0.802-0.806
0.01-0.02	0.798-0.802



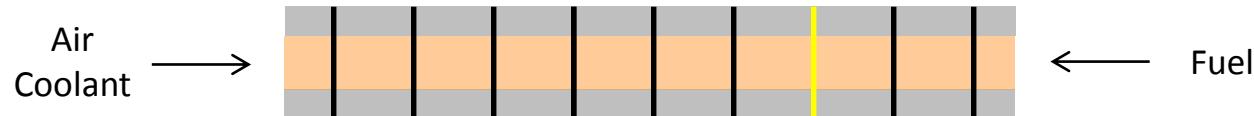
Reactant composition profiles (375A)



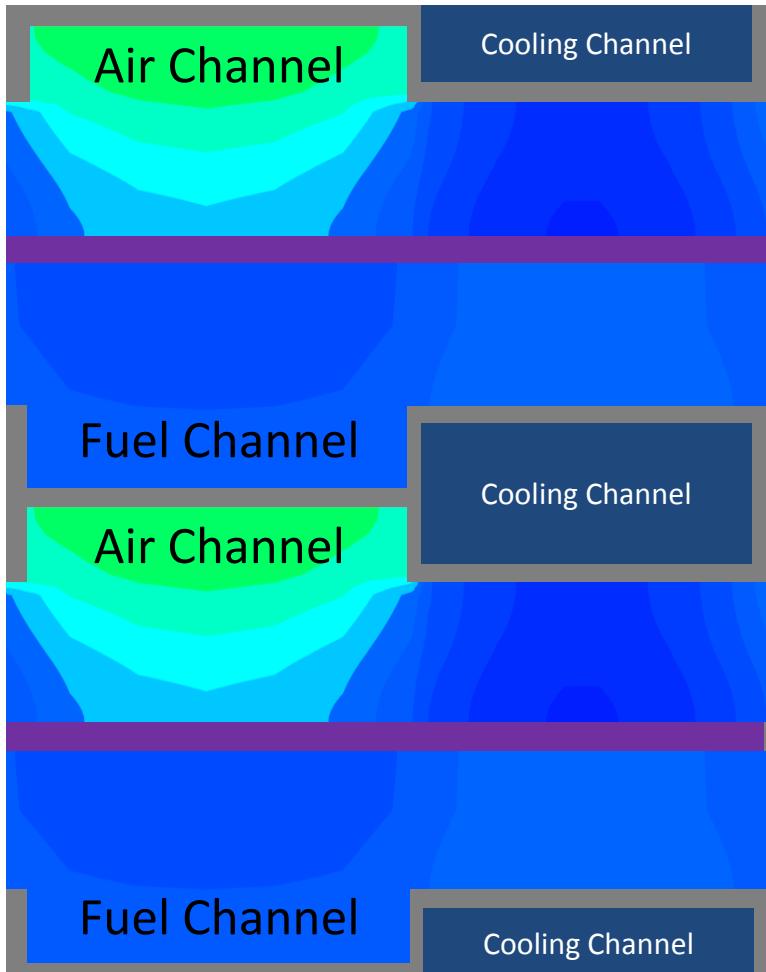
Oxygen Molar Fraction	Hydrogen Molar Fraction
0.16-0.17	0.858-0.862
0.15-0.16	0.854-0.858
0.14-0.15	0.85-0.854
0.13-0.14	0.846-0.85
0.12-0.13	0.842-0.846
0.11-0.12	0.838-0.842
0.1-0.11	0.834-0.838
0.09-0.1	0.83-0.834
0.08-0.09	0.826-0.83
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0.03-0.04	0.806-0.81
0.02-0.03	0.802-0.806
0.01-0.02	0.798-0.802



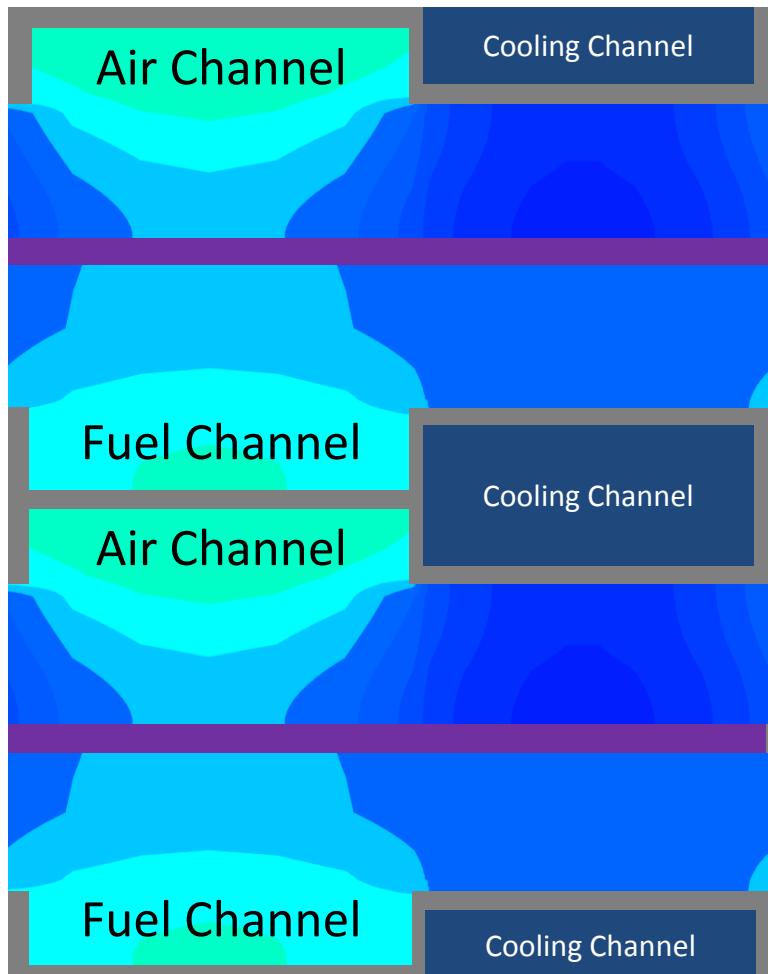
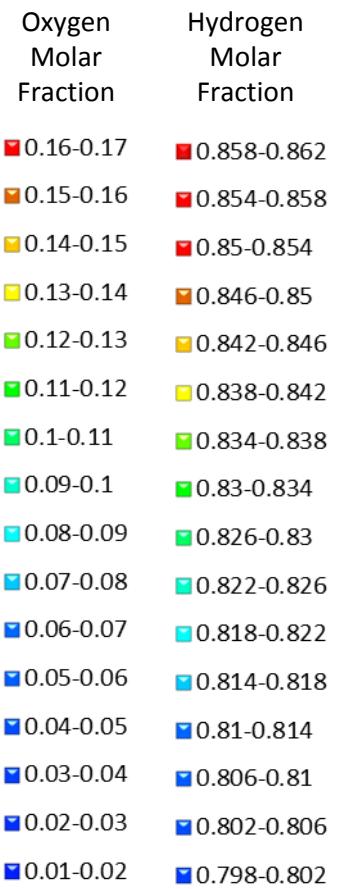
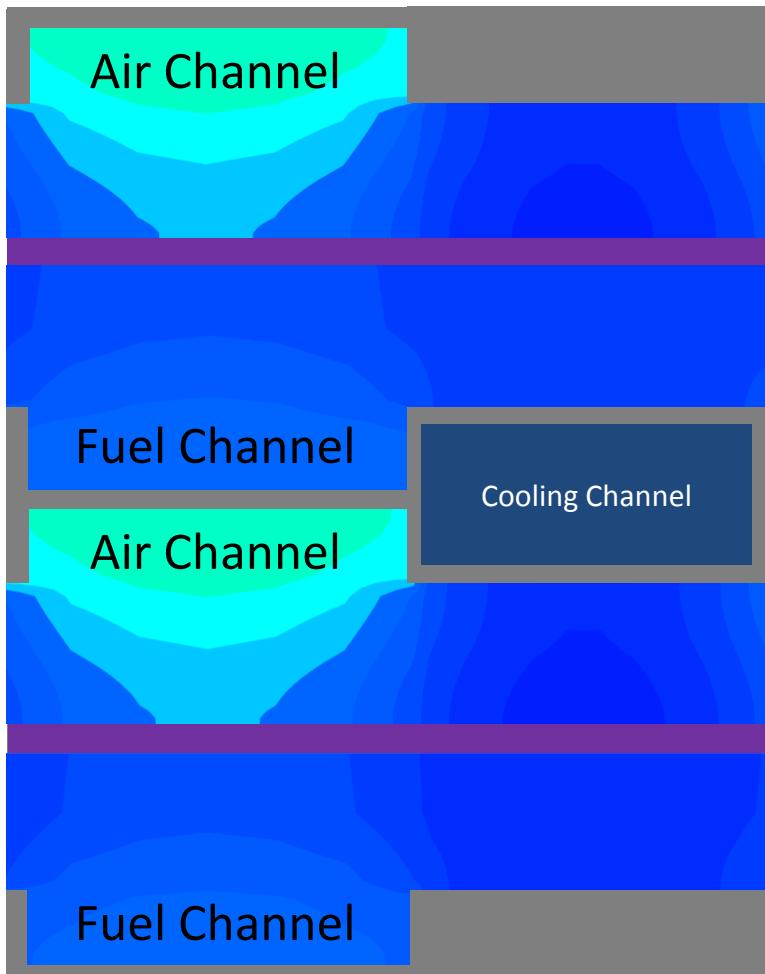
Reactant composition profiles (375A)



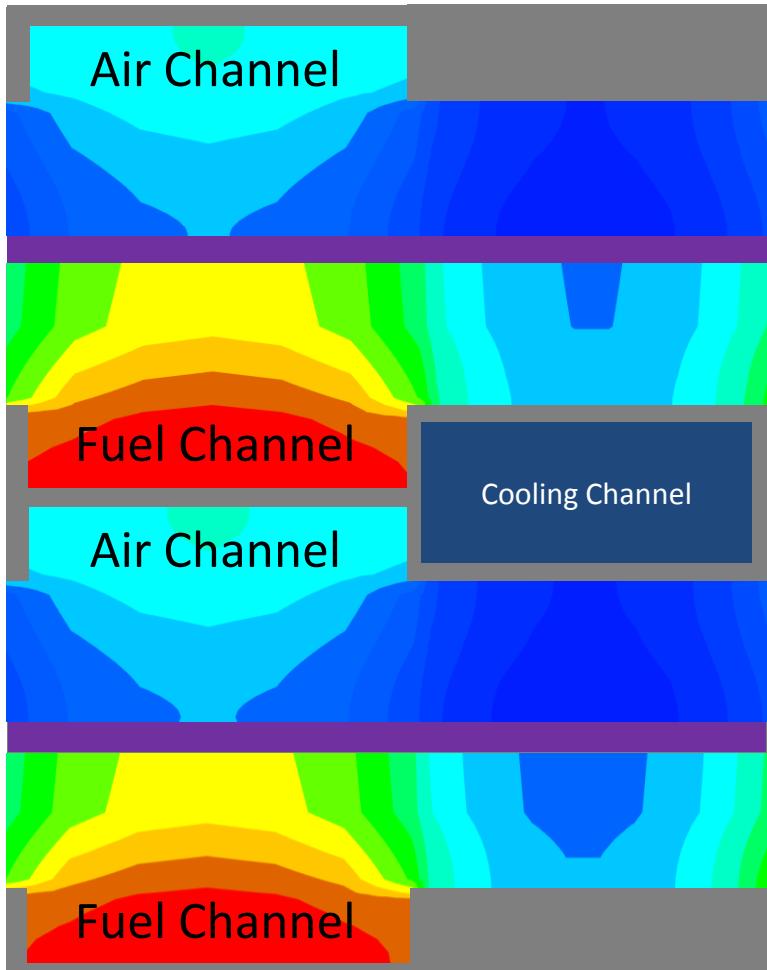
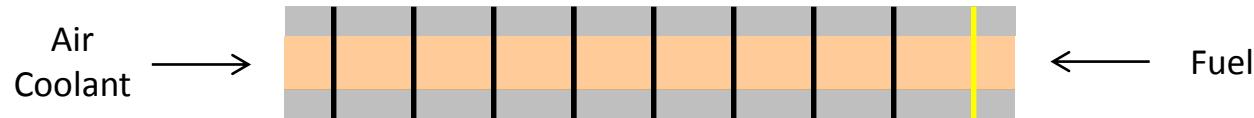
Oxygen Molar Fraction	Hydrogen Molar Fraction
0.16-0.17	0.858-0.862
0.15-0.16	0.854-0.858
0.14-0.15	0.85-0.854
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0.07-0.08	0.822-0.826
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0.03-0.04	0.806-0.81
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0.01-0.02	0.798-0.802



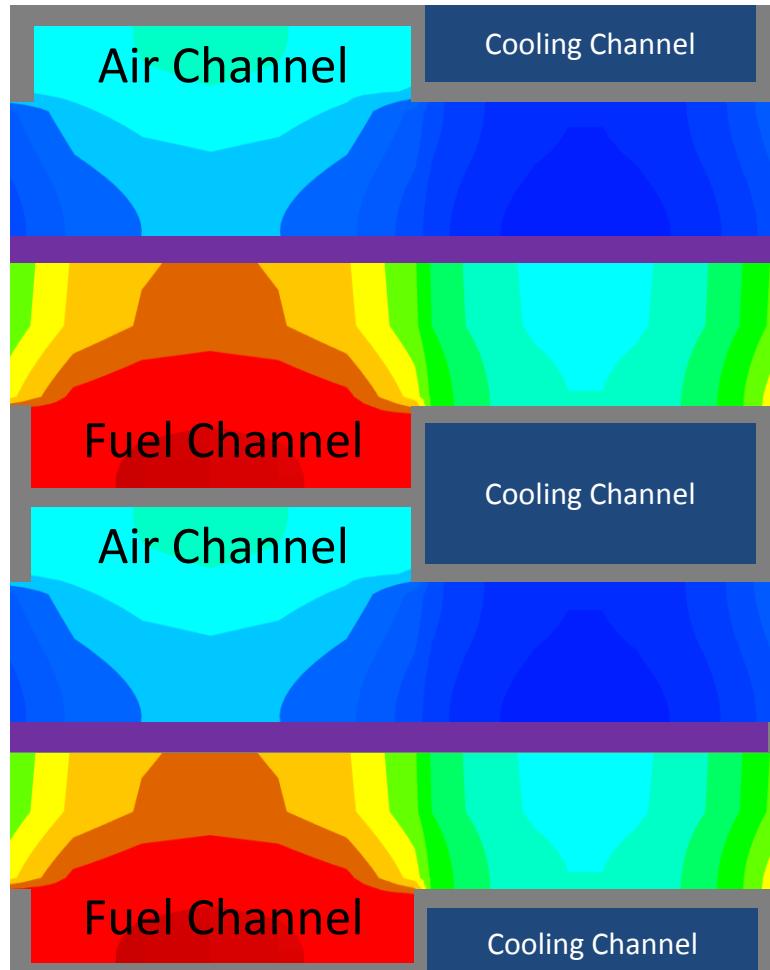
Reactant composition profiles (375A)



Reactant composition profiles (375A)



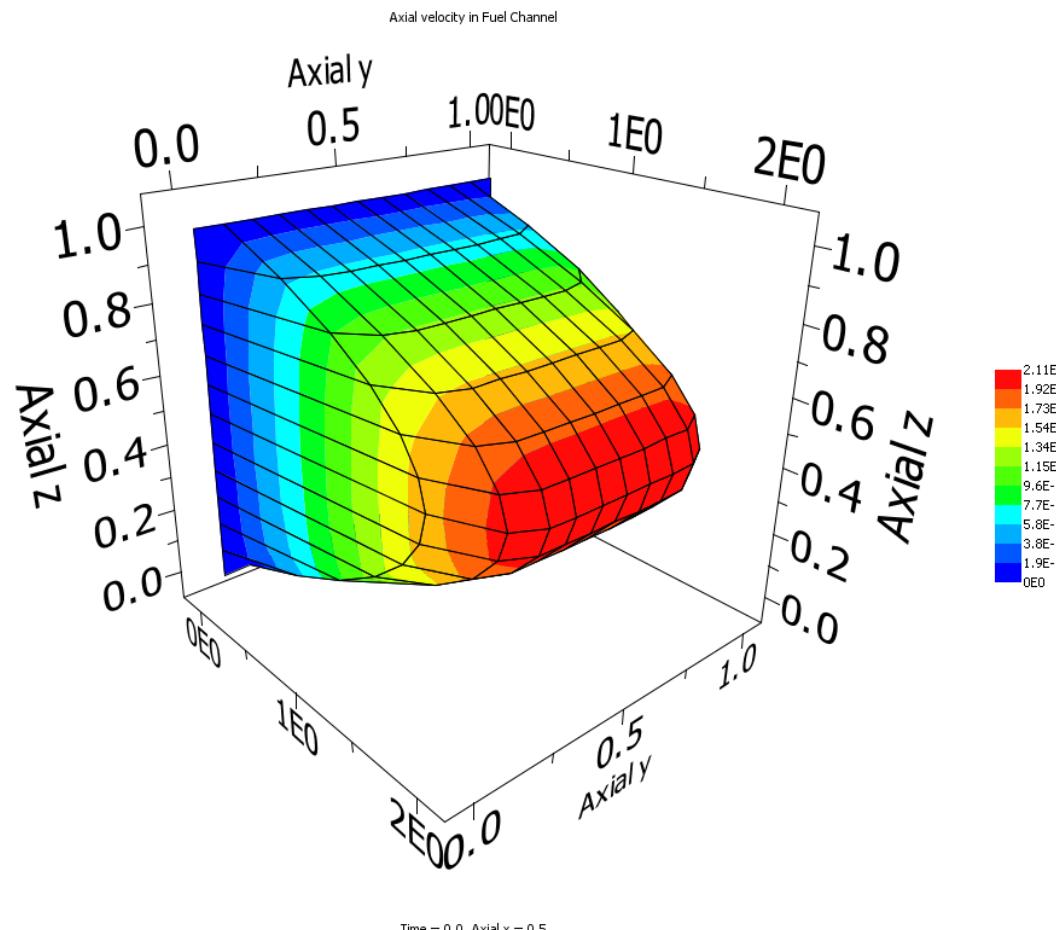
Oxygen Molar Fraction	Hydrogen Molar Fraction
0.16-0.17	0.858-0.862
0.15-0.16	0.854-0.858
0.14-0.15	0.85-0.854
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0.07-0.08	0.822-0.826
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0.01-0.02	0.798-0.802



Solution of Navier-Stokes equations in gPROMS

Navier-Stokes solution in Fuel Cell stack geometry

Velocity Profile in Fuel Channel



gPROMS capability for high fidelity modelling of Fuel Cells to become a tool optional to CFD



- The high fidelity modelling technology in gPROMS equals the resolution of CFD tools
- The geometry is to be limited to a “Lego blocks” representation
- gPROMS provides many advanced modelling capabilities that cannot be provided by CFD: detailed phenomenological modelling, dynamics, systems-level modelling with the same platform
- Such technology is in demand from the FC stack development divisions at automotive industry with the main objectives to:
 - identify the deficiencies of standard designs of FC stacks that are in use at present
 - efficiently verify novel concepts of FC stacks design
- The gPROMS software is acknowledged as the best modelling platform for high fidelity models of Fuel Cells because of its build-in functionality to validate the models against large pools of experimental data.
- In addition, gPROMS has been proven to reliably solve the highly non-linear models of liquid water management in PEM stacks



ADVANCED PROCESS MODELLING
FORUM 22–23 APRIL 2015

Thank you

