DOLPHIN

Disruptive pemfc stack with n**O**vel materia**L**s, **P**rocesses, arc**H**itecture and optimized **IN**terfaces

Global technological progress for the different development paths

(Joël PAUCHET, CEA)

Increase of performance

1.13 W/cm² **Achievement to-date** 1.38 W/cm²

2W/cm²

25% 50% 75%

Global progress

Increase of performance

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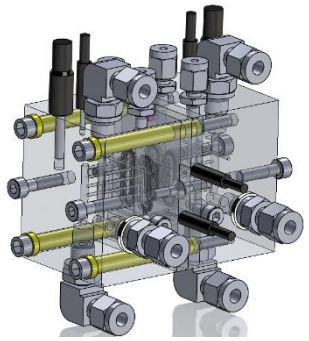
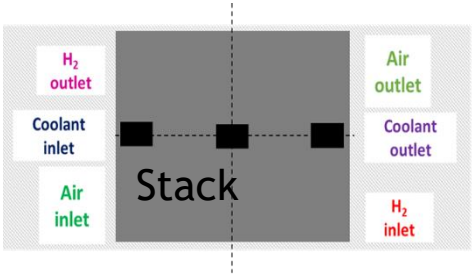


Differential cell (1.8 cm²) to mimic local conditions in the stack (CEA)



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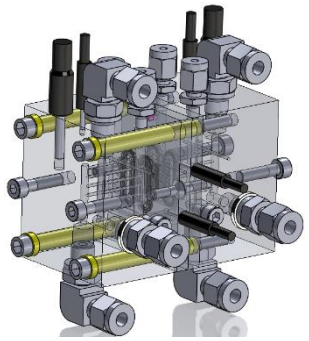

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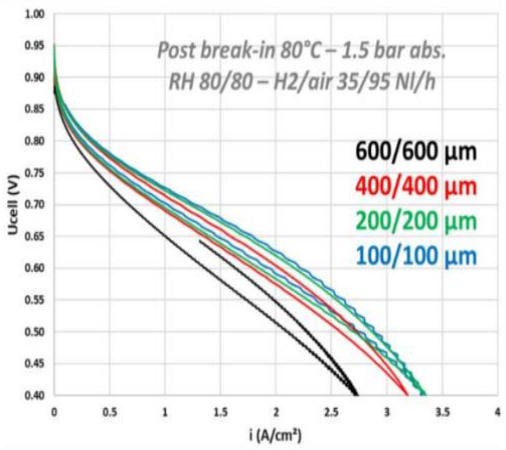
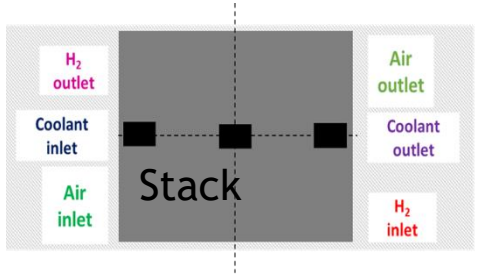
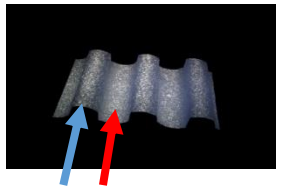


Increase of performance by reducing rib/channel pitch (CEA)





Rib/channel pitch

Global progress

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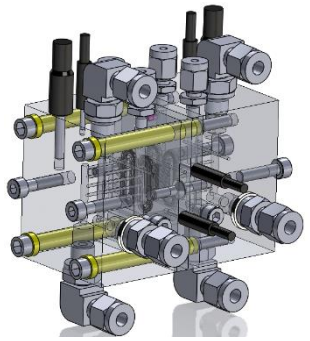

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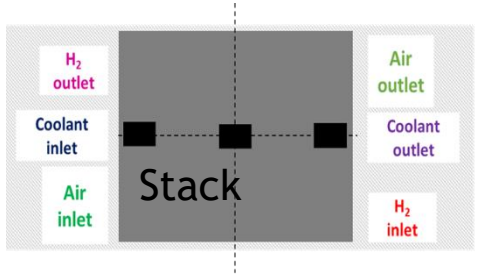
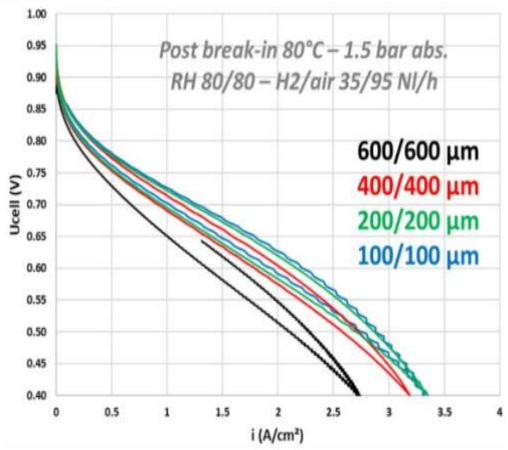
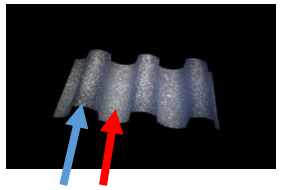


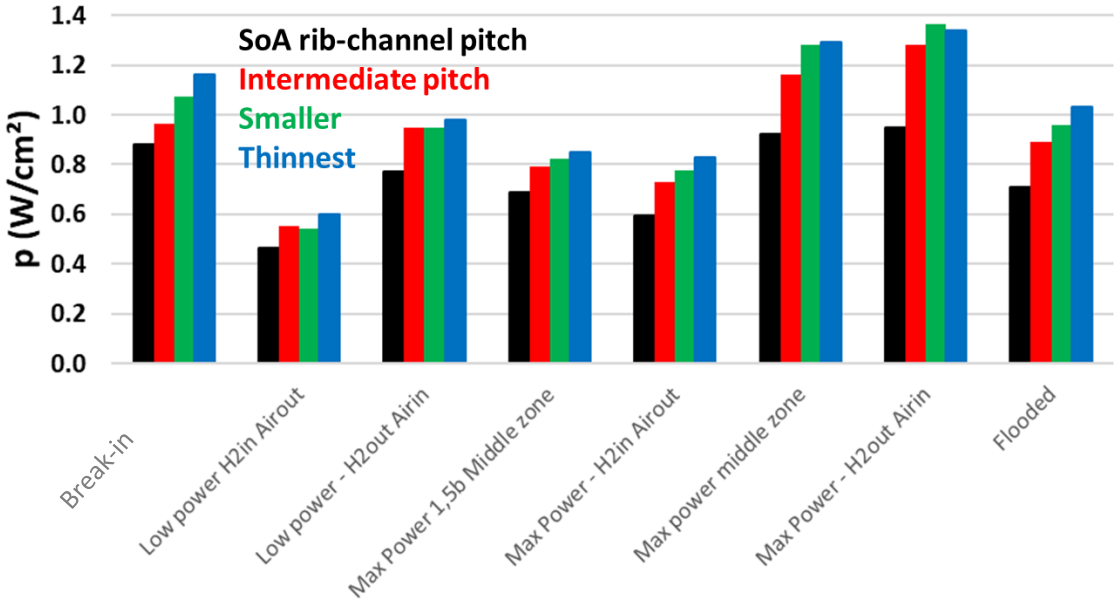


Increase of performance by reducing rib/channel pitch (CEA)



Rib/channel pitch

25% 50% 75%



Performance for different local conditions expected in the stack: machined flow-fields with different dimensions, commercial CCM (CEA)

Global progress

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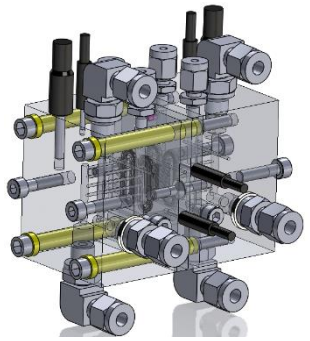

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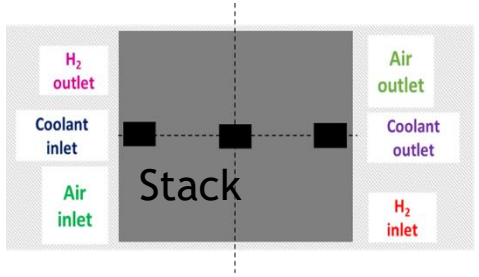

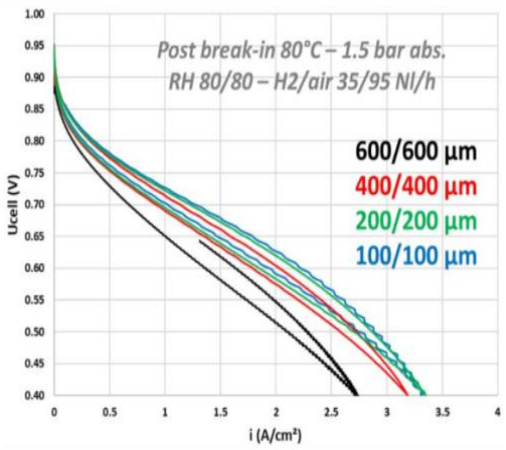

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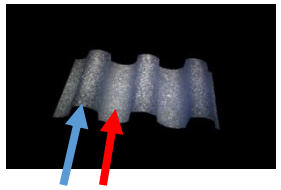
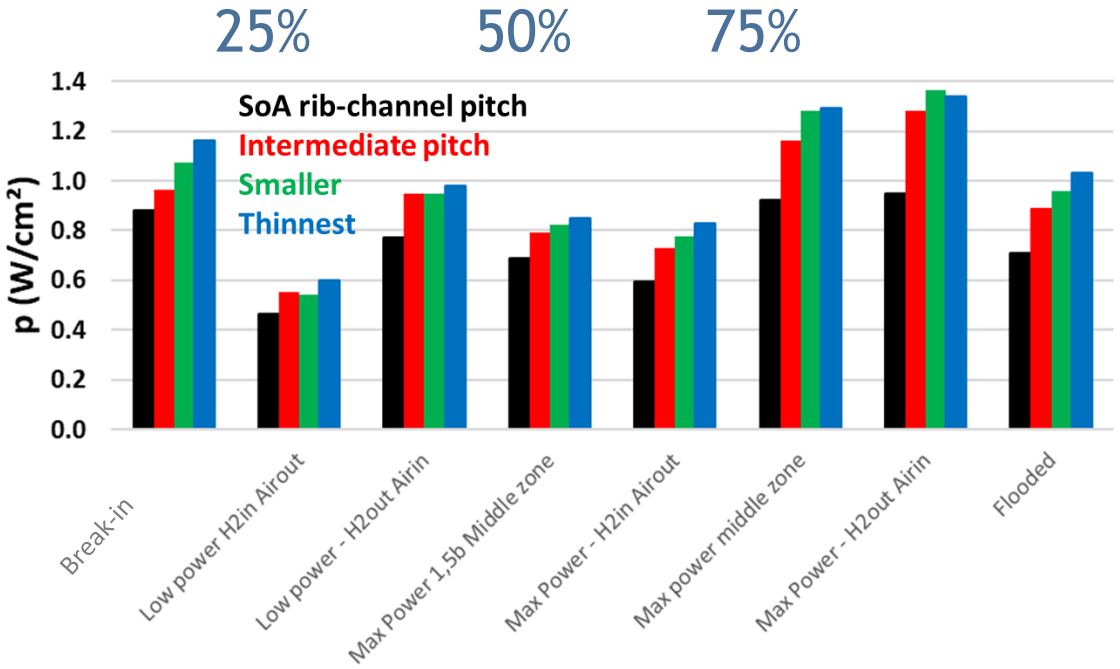


Rib/channel pitch



Performance for different local conditions expected in the stack: machined flow-fields with different dimensions, commercial CCM (CEA)

Next:
- Trade-off 'performance increase' vs 'pressure drop increase'
- Larger cell tests
- Thin GDL or no GDL

Global progress

Manufacturing of thin Flow-Fields

Metallic
Stamped
Pitch 1,2 mm

Achievement to-date

Metallic or Carbon
Different processes
Pitch 0,4 mm

Other materials
Other process
Pitch << 1,2 mm

25% 50% 75%

- Thin metallic sheets
- Thin carbon sheets
- 3D additive manufacturing
- 3D laser milling
- 3D printing
- Stamping
- 3D molding

Global progress

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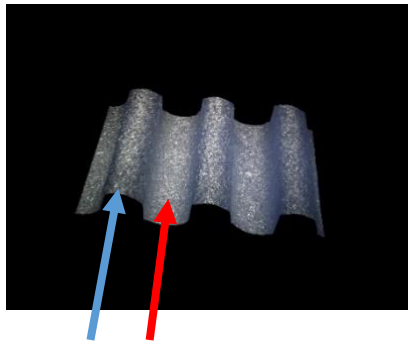

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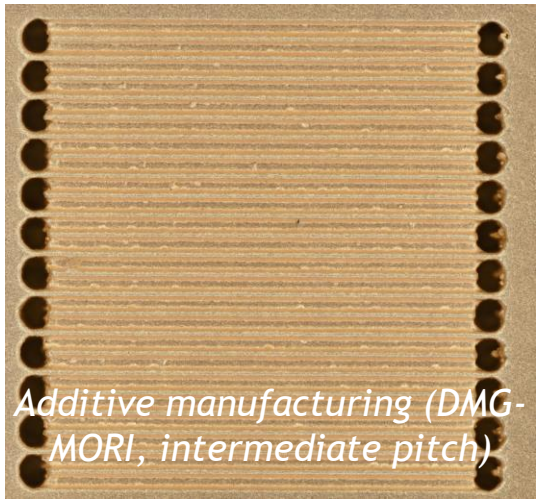
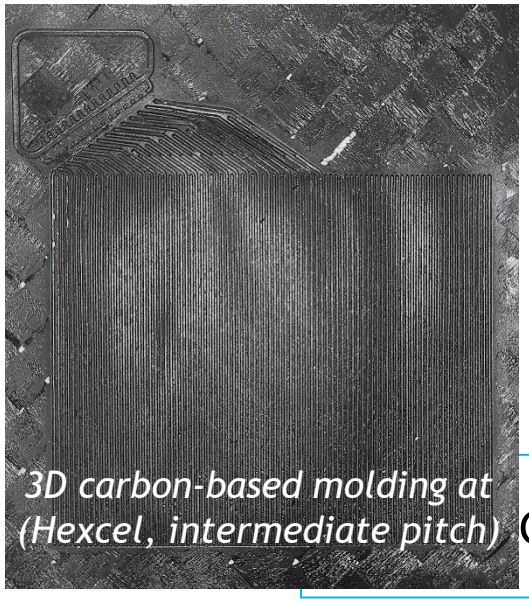
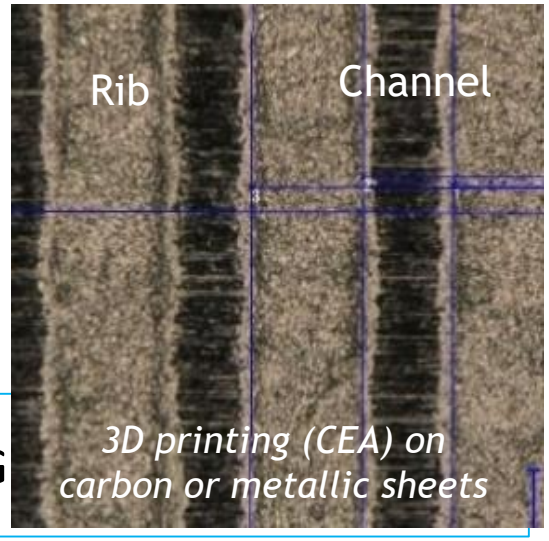


Additive manufacturing (DMG-MORI, intermediate pitch)

- Thin metallic sheets
- Thin carbon sheets
- 3D additive manufacturing
- 3D laser milling
- 3D printing
- Stamping
- 3D molding



3D carbon-based molding at (Hexcel, intermediate pitch)



3D printing (CEA) on carbon or metallic sheets

Manufacturing of thin Flow-Fields

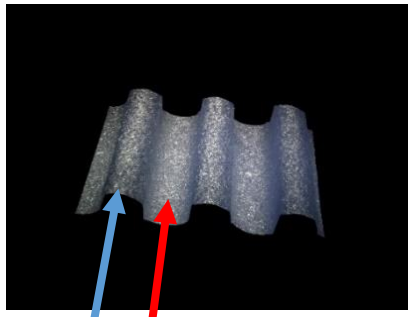
Metallic
Stamped
Pitch 1,2 mm

Achievement to-date

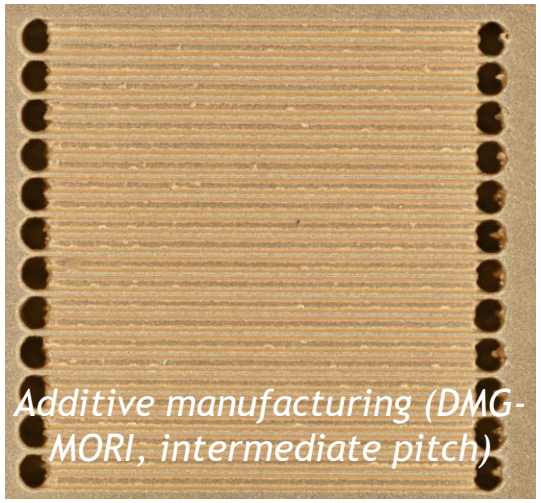
Metallic or Carbon
Different processes
Pitch 0,4 mm

25% 50% 75%

Other materials
Other process
Pitch << 1,2 mm



Rib/channel pitch



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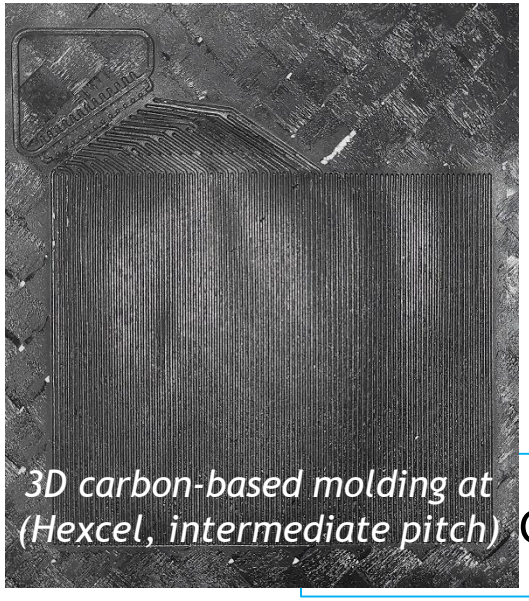
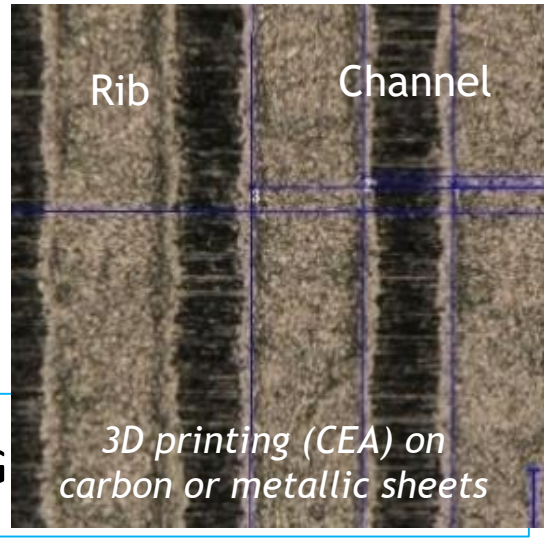


3D carbon-based molding at (Hexcel, intermediate pitch)



3D printing (CEA) on carbon or metallic sheets

- Thin metallic sheets
- Thin carbon sheets
- 3D additive manufacturing
- 3D laser milling
- 3D printing
- Stamping
- 3D molding

Next:
- Increase of electrical conductivity
- Single cell test
- Select most promising solutions for larger scale tests

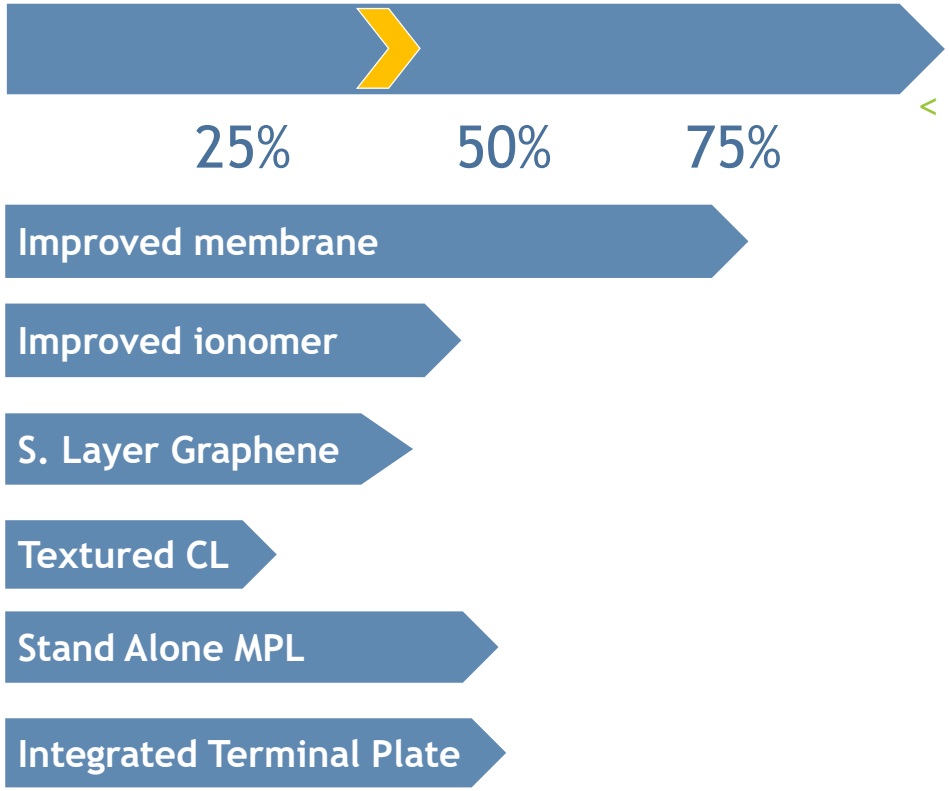
Electrochemical Core, Terminal Plate

Achievement to-date

No SLG
18 µm membrane
Metallic ITP

First SLG
10 µm membrane
Composite ITP

SLG
< 10 µm membrane
Light ITP



Global progress

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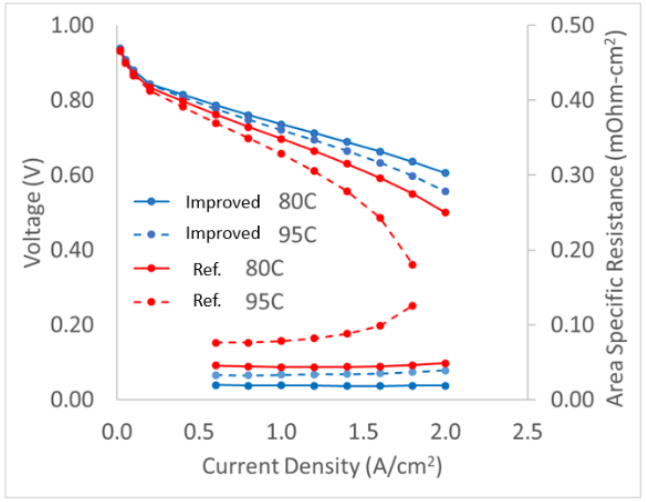
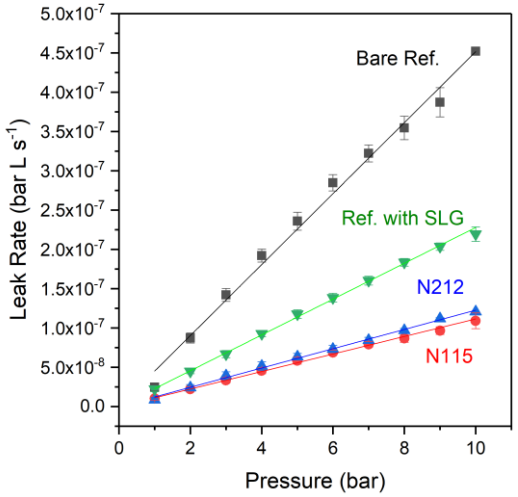
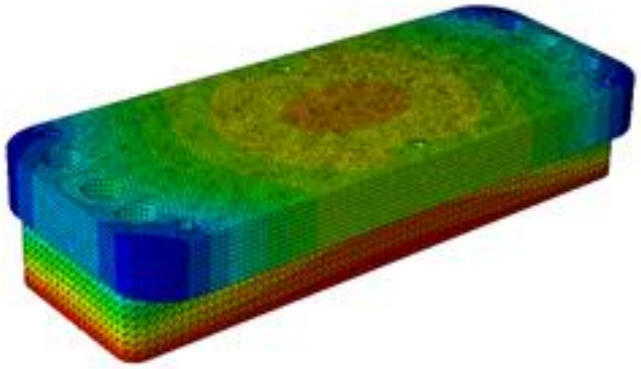


Improved 10µm thick membrane (Chem)



Single Layer Graphene coating to reduce H_2 permeation (UoM)

- Improved membrane
- Improved ionomer
- S. Layer Graphene
- Textured CL
- Stand Alone MPL
- Integrated Terminal Plate



Integrated Lighter Composite Terminal Plate (Hexcel)

progress

Electrochemical Core, Terminal Plate

Achievement to-date

No SLG
18 µm membrane
Metallic ITP

First SLG
10 µm membrane
Composite ITP

SLG
< 10 µm membrane
Light ITP

25% 50% 75%

- Improved membrane
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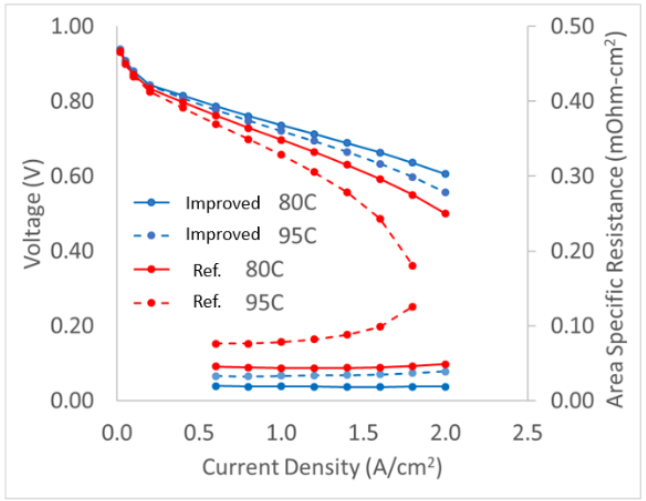
- S. Layer Graphene
- Textured CL
- Stand Alone MPL
- Integrated Terminal Plate



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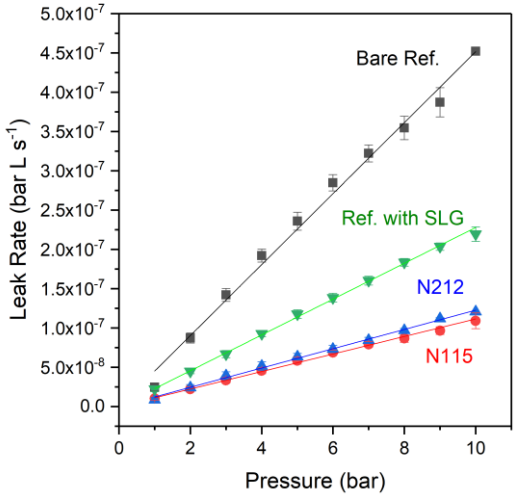

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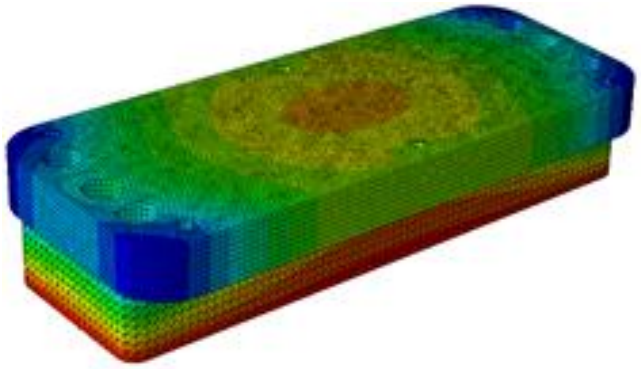
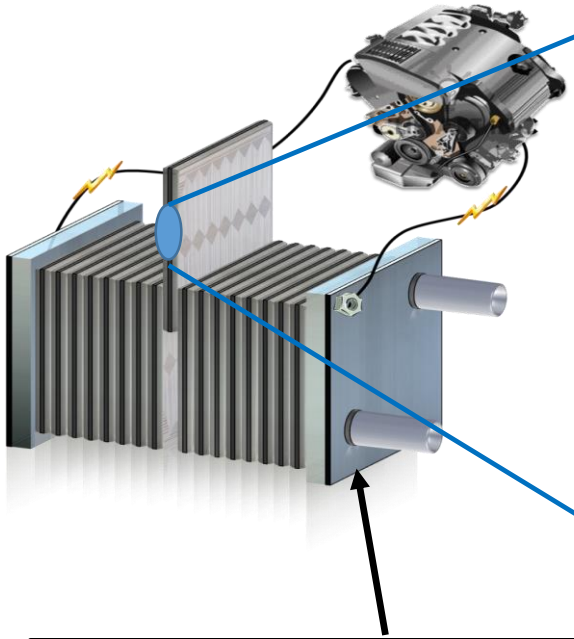


Integrated Lighter Composite Terminal Plate (Hexcel)

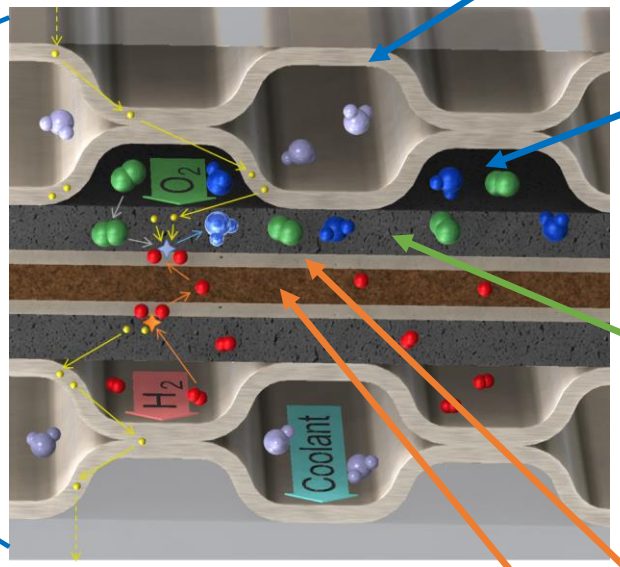
Next:
- improve MPL and SLG coating
- manufacture/test ITP

progress

Some highlights in the following presentations



3D Lighter Integrated Terminal Plate (composite, HEXCEL)



Thinner carbon-based plates (HEXCEL)
Thinner metallic plates (SYM)
Treatments of plates (SYM, CEA)

New (ZSW, CEA, SYM) Flow Field design with downsized rib/channel pitch by printing (CEA), molding (HEXCEL), stamping (SYM), additive manufacturing (DMG-MORI), laser milling (ZSW)

Electrical and Fluidics Core

Thin GDL substrate (HEXCEL), with MPL and treatments (CEA)
Or only MPL coated onto AL (ZSW)

Interfaces

3D textured cathode AL (CEA) with improved ionomers (CHEM)

Thinner (<10 µm) or beyond PFSA membrane (CHEM) with SLG coating (UoM)

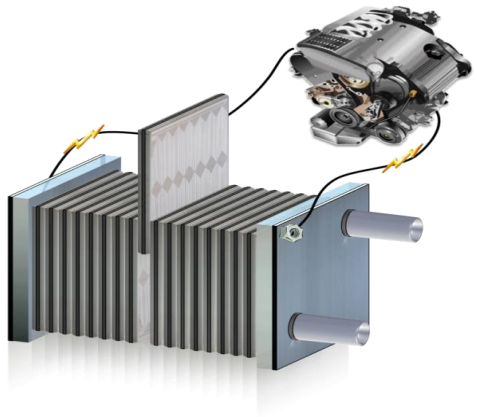
Electrochemical Core

Global progress

Thank you for your attention!

DOLPHIN

Disruptive pemfc stack with nOvel materiaLs, Processes, arcHitecture and optimized INterfaces



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DOLPHIN Project: 1st public workshop (cell and manufacturing technologies) - virtual – 18/06/2021