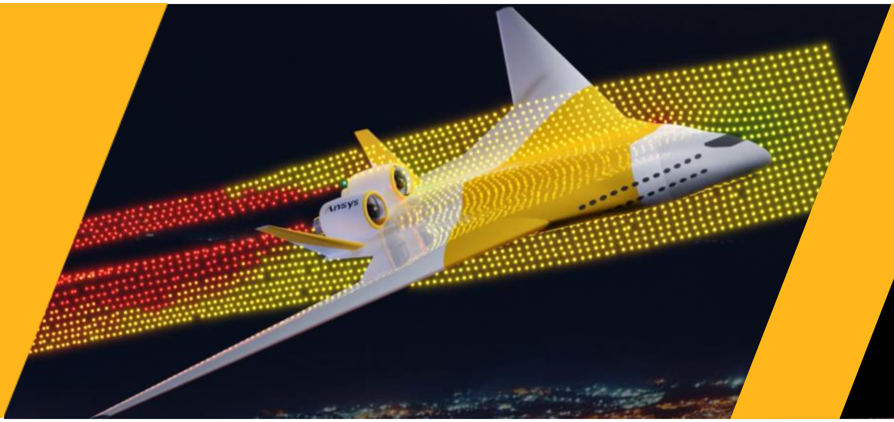
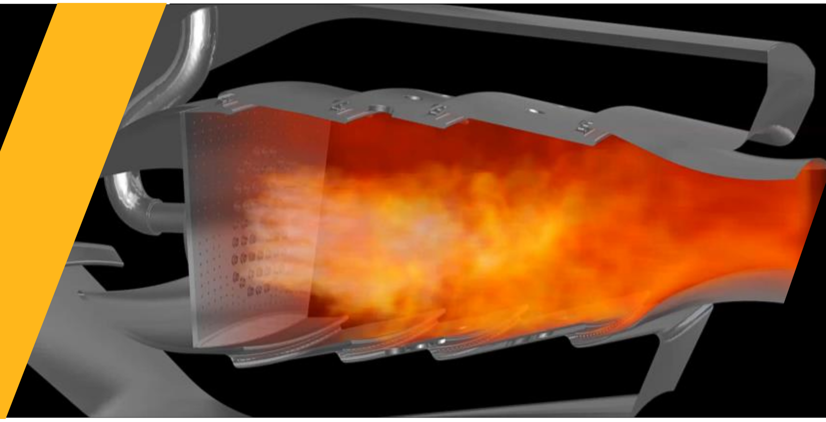
ANSYS CFD 2022R2 新功能介绍

新科益系统与咨询（上海）有限公司

Efficient and Sustainable Fluent Simulations





Unleash the Full Power of GPUs for Fluent Simulations

- ✓ Reduce simulation **solve time** and **total power consumption** with a native multi-GPU solver in Fluent.
- ✓ 1 GPU ≈ 400 CPUs.
- ✓ Support for transient simulations, including high-fidelity turbulent flows and moving parts.
- ✓ Built on the same numerical methods as the Fluent CPU solver, providing users **virtually identical results**.

Harness the Power of Fluent in Python to Craft Customized Solutions

- ✓ Build customized solutions meeting your unique needs for **more efficient** CFD simulations
- ✓ Interface with Fluent pythonically to **automate** its capabalities and seamlessly connect with other technologies
- ✓ Access to all Fluent TUI commands from pre- to post-processing in your python scripts
- ✓ Extract solution fields and leverage python libraries for **more sophisticated** data analyses

Accurate and Validated Hydrogen Generation and Consumption Models

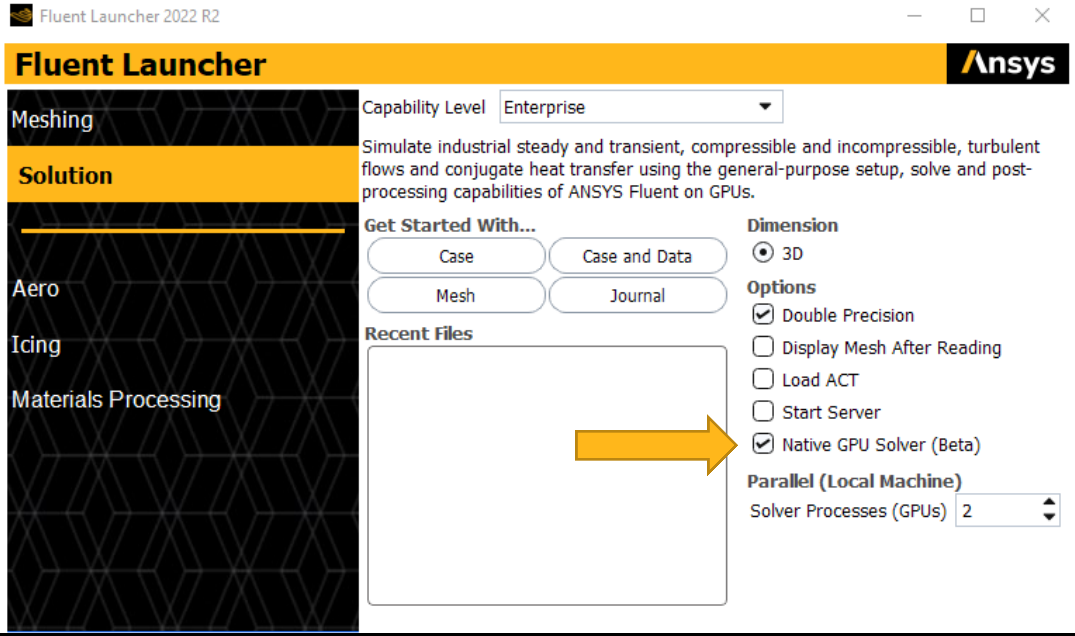
- ✓ Solutions from production to consumption
- ✓ Simulate the generation of **green** hydrogen through electrolysis with a **new** Proton Exchange Membrane (PEM) model (beta)
- ✓ **Validated** hydrogen and hydrogen blend combustion models with **accurate** prediction of flashback

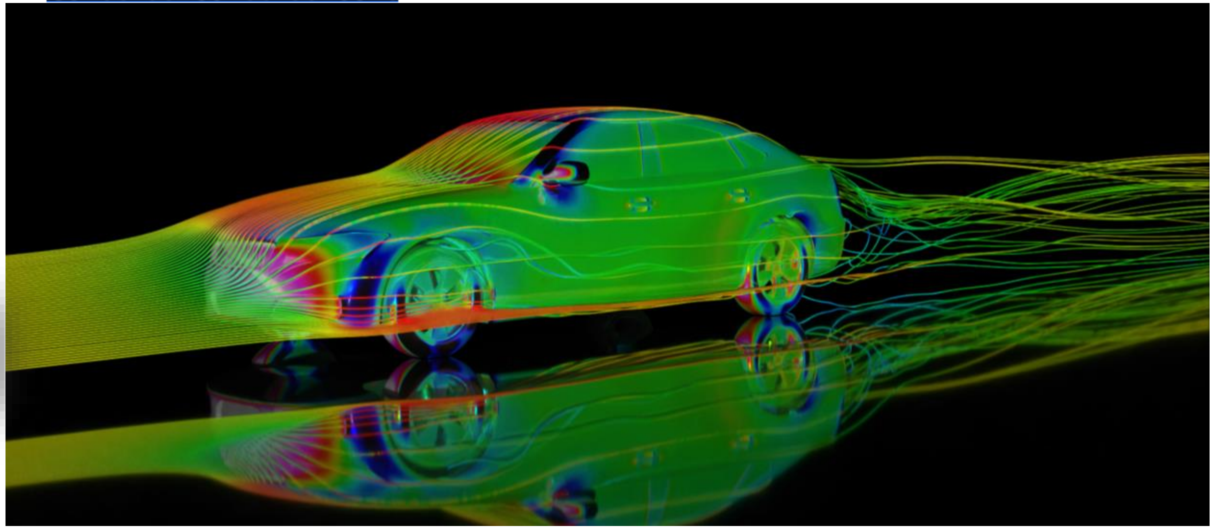
Native Multi-GPU Solver

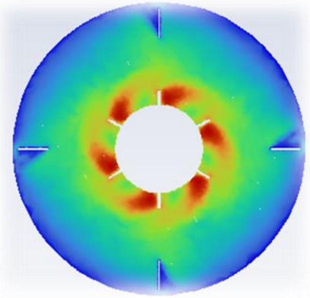
CAD-IT CONSULTANTS

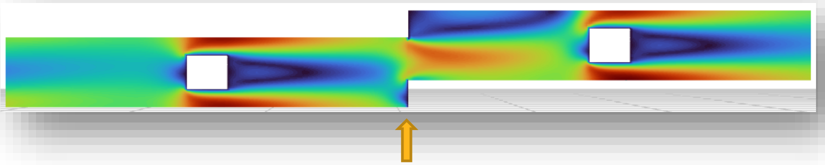
Native Multi-GPU Solver

- **Multi-GPU Solver (beta)**
  - Run Fluent simulations natively on multiple GPUs
- **New Modeling Capabilities**
  - Transient flows
  - Scale-resolving simulations (SRS)
  - Moving reference frame (MRF)
  - Non-conformal mesh interfaces
  - Porous media
  - For full list of features visit Fluent documentation







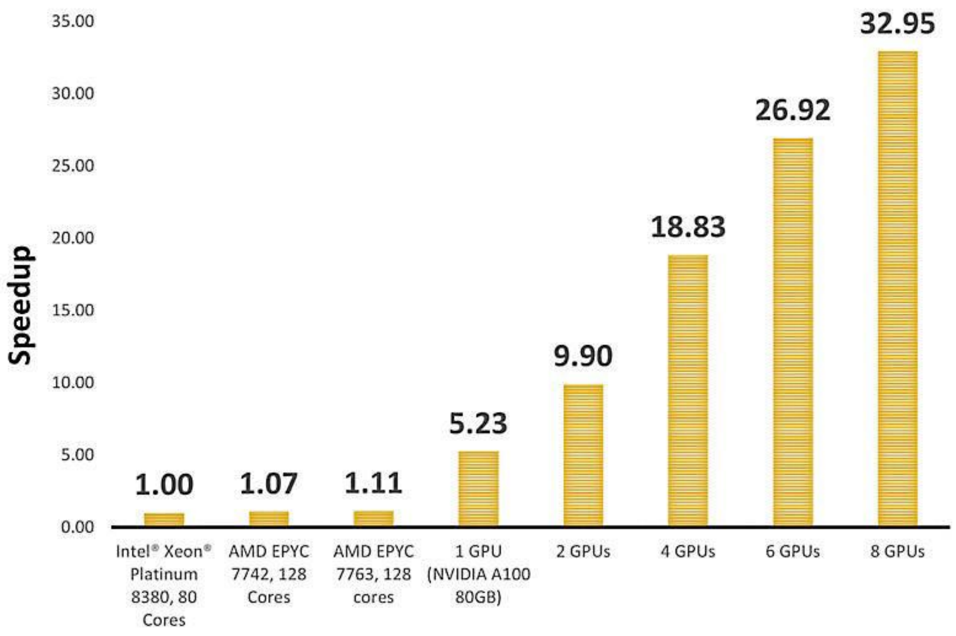


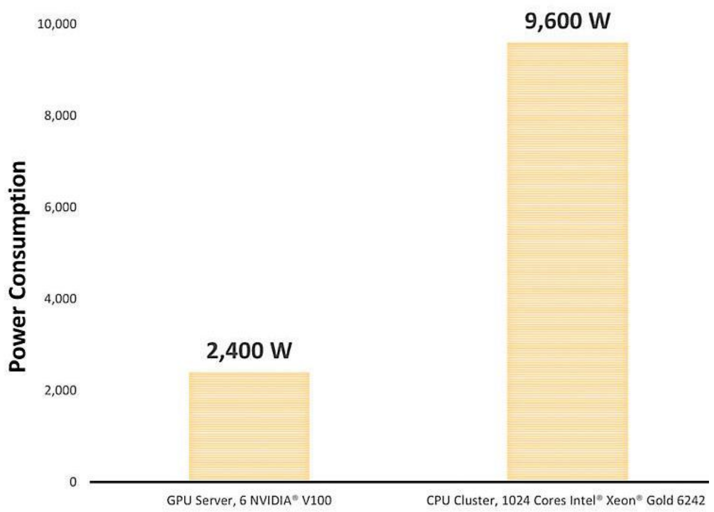
Non-conformal interface

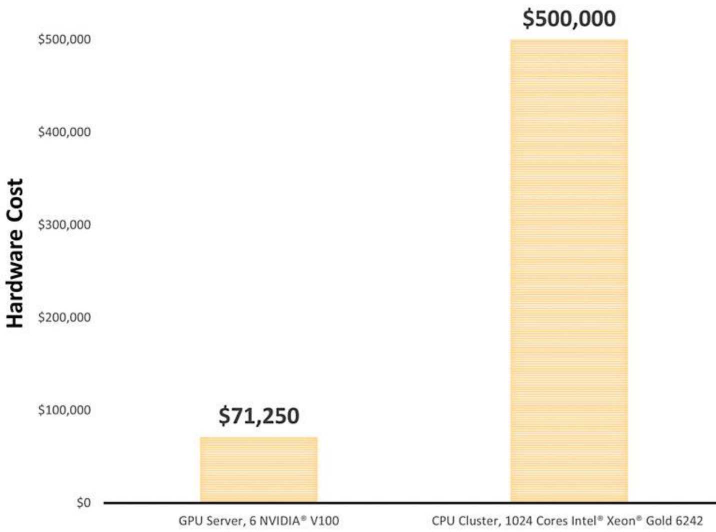
Steady-state mixer with MRF + GEKO

Native Multi-GPU Solver

- **32X Simulation Speed Up**
  - Running Fluent simulations natively on multiple GPUs can increase performance
  - A single NVIDIA A100 GPU achieved more than 5X greater performance than a cluster with 80 Intel® Xeon® Platinum 8380 Cores
- **Power Consumption Reduction**
  - Running simulations natively on multiple GPUs can have significant power consumption savings
  - CPU cluster with 1024 Intel® Xeon® Gold 6242 cores
    - Power consumption = 9,600 W
  - GPU server with 6 NVIDIA® V100
    - Power consumption = 2,400 W
- **7X Hardware Cost Reduction**



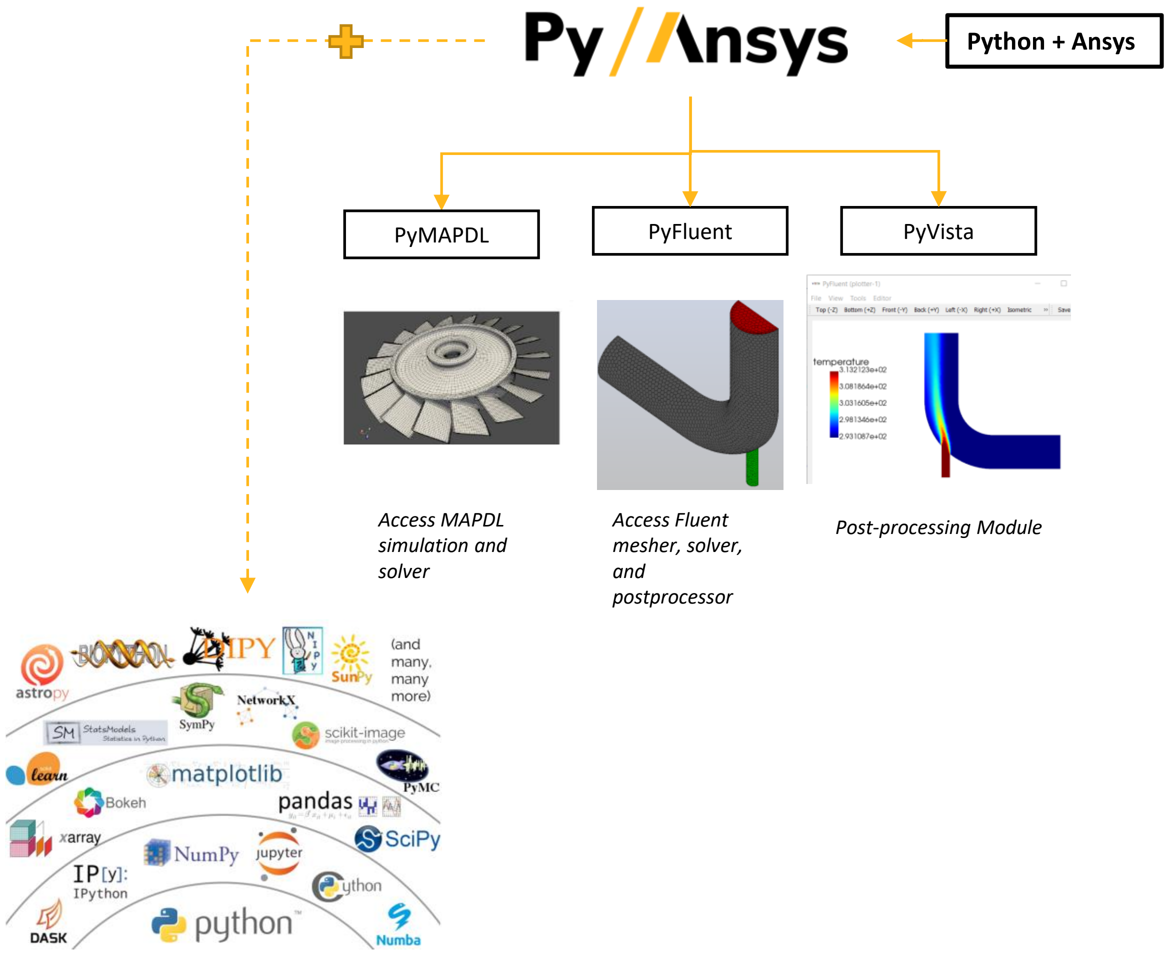




PyFluent

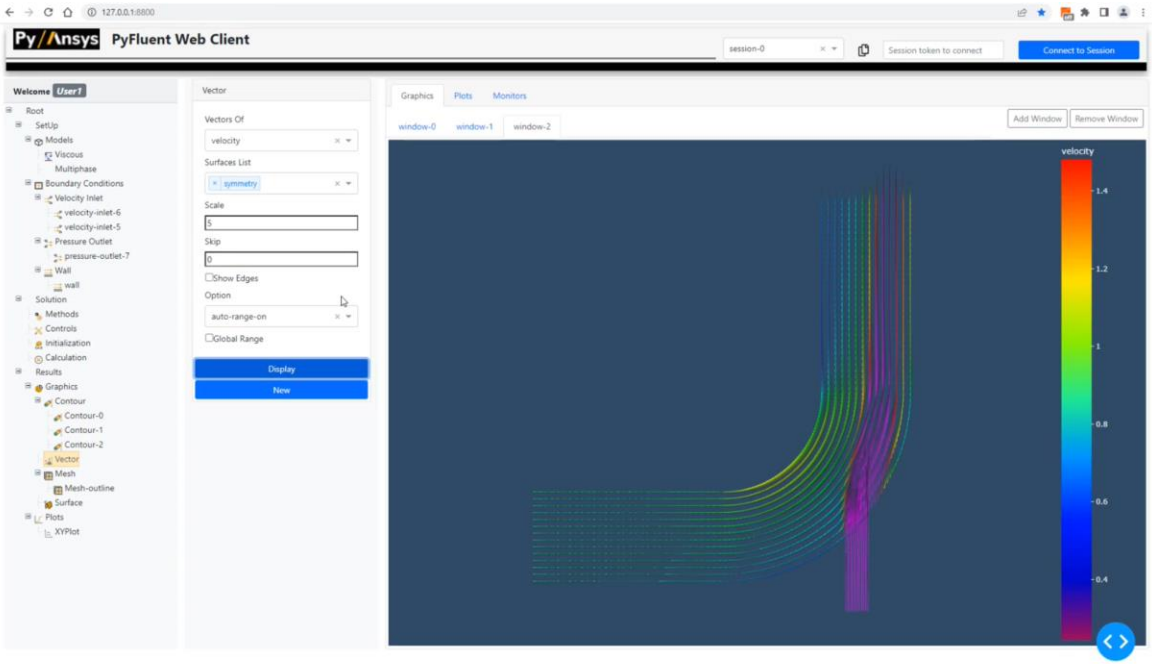
PyFluent - Opensource Accessibility for Fluent

- **PyAnsys**
  - PyAnsys is a set of technologies that allows the user to interface with Fluent, MAPDL, AEDT and other Ansys products pythonically.
  - Ansys's commitment to open-source where we provide Python libraries that expose Ansys technologies in the Python ecosystem through APIs and interfaces that are clear, concise, and maintainable.
- **Enabling Users To Do:**
  - Flexible Automation: Democratize powerful capabilities offered by Ansys through scripting
  - Flexible Distribution : Connect Ansys and Open-Source technologies in a seamless manner
  - Broader Technology Integration: Integrate Ansys physics capabilities easily with AI/ML



PyFluent - Opensource Accessibility for Fluent

- **PyFluent Capabilities**
  - Use Fluent within, or alongside, any other Python environment
    - Conjunction with other Ansys Python libraries/packages
    - With other external Python products.
  - Access to all Fluent TUI commands for meshing, solving, and postprocessing
  - Extract post processing (field) data and use with standard Python tools
    - PyVista, NumPy, SciPy, Matplotlib, etc…
  - Build custom workflows




```
/define> materials

/define/materials> change-create

material-name> air
material name [air] air
air is a fluid
change Density? [no] yes

Density
methods: (constant ideal-gas incompressible-idea
expression compressible-liquid user-defined)
new method [constant] ideal-gas
no data required.

change Cp (Specific Heat)? [no] no
change Thermal Conductivity? [no] no
change Viscosity? [no] no
```

PyFluent (TUI API)

```
session.tui.solver.define.materials.change_create('air','air','yes','ideal-gas','no','no','no','no','no','no')
```

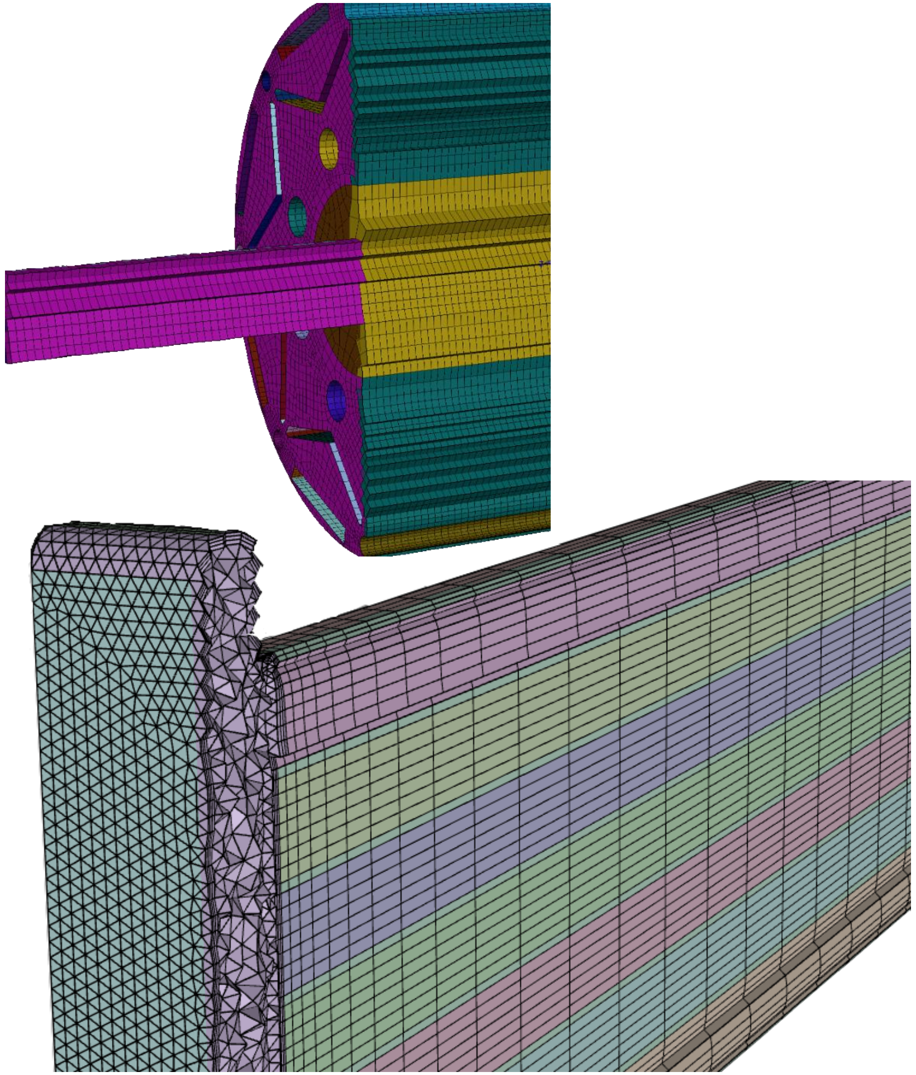
PyFluent (Settings API) [beta]

```
root.setup.materials.fluid['air']={'density':{'option':'ideal-gas'}}
```

Efficient Structured Meshing

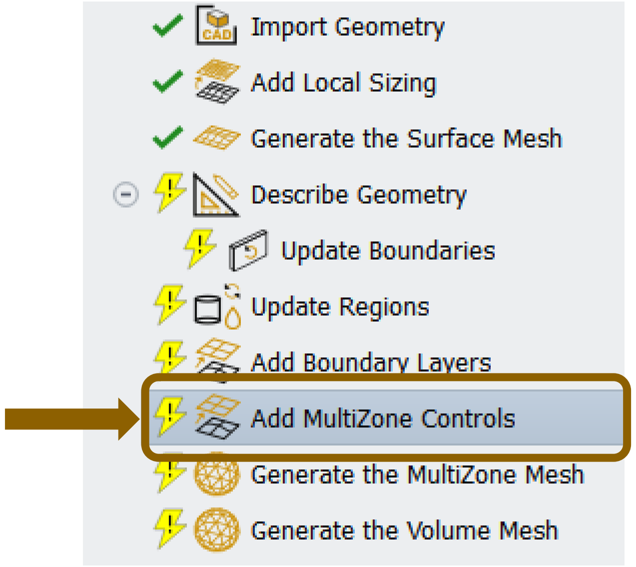
Efficient Structured Meshing – Watertight Geometry Workflow

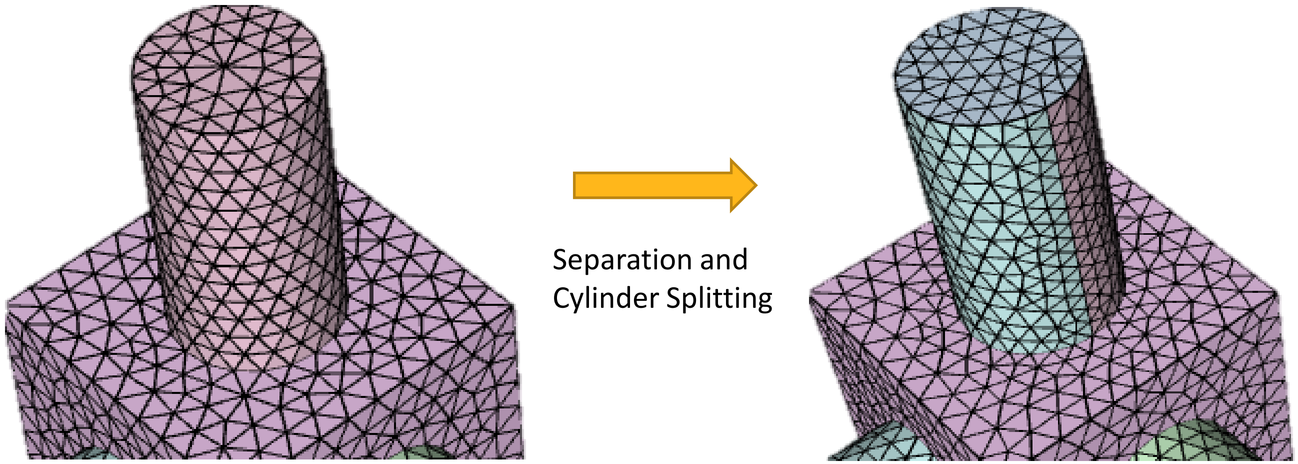
- **MultiZone provides efficient swept / extruded meshes**
  - Now integrated into the Watertight Geometry workflow
- **Mix MultiZone and Unstructured meshing**
  - Generate the MultiZone Mesh task before remaining volume fill
  - Regions that are connected will be meshed at the same time
    - If all regions have controls and all regions are selected, Generate the Volume mesh task will be hidden
  - Volume meshing of remaining regions
    - Conformal connections between Multizone and Tet-Hexcore
      - Unless defined as non-conformal in CAD
    - Non conformal connections between Multizone and Poly / Poly-Hex



Efficient Structured Meshing Capabilities

- **Main Operations**
  - Separate Zones
    - Based on Face Zones or Regions (body labels)
    - Separation Angle
  - Split Cylinders
    - Based on Face Zones or Regions (body labels)
    - Split will also create Edge labels around split faces
  - Separated faces are merged back after volume meshing

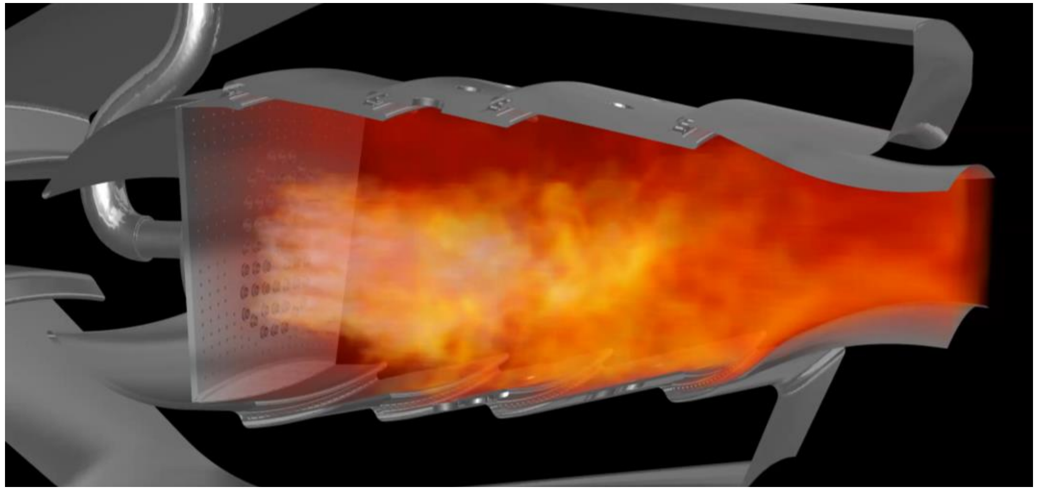


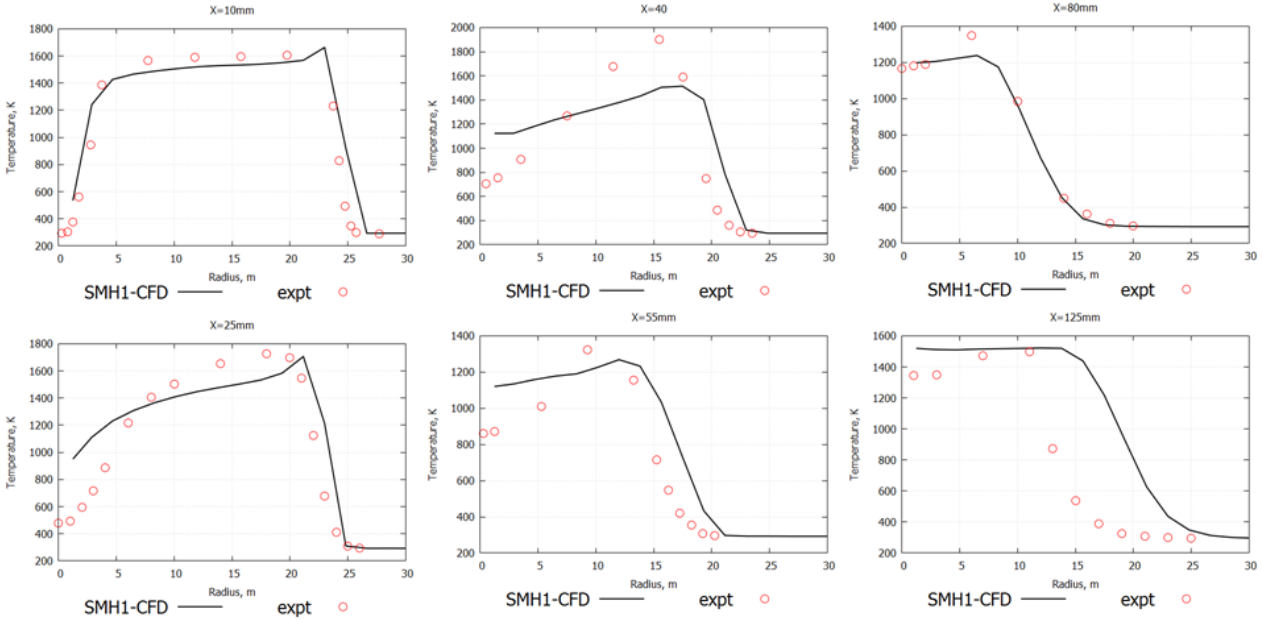


Hydrogen

Validated Hydrogen Combustion Models

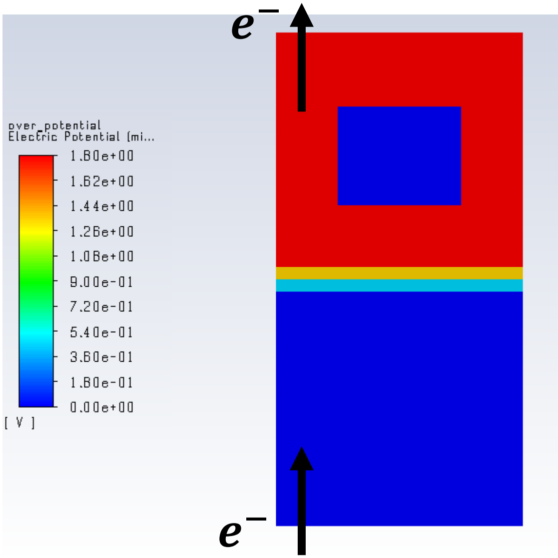
- **Hydrogen Combustion**
  - Validated hydrogen and hydrogen blend combustion models
    - Accurate prediction of flashback
  - Accurate combustion simulations using finite rate (FR) and Flamelet-Generated Manifold (FGM) combustion models
  - Ability to include larger reaction mechanisms in the simulations
  - Scalable performance on HPC for combustion modeling

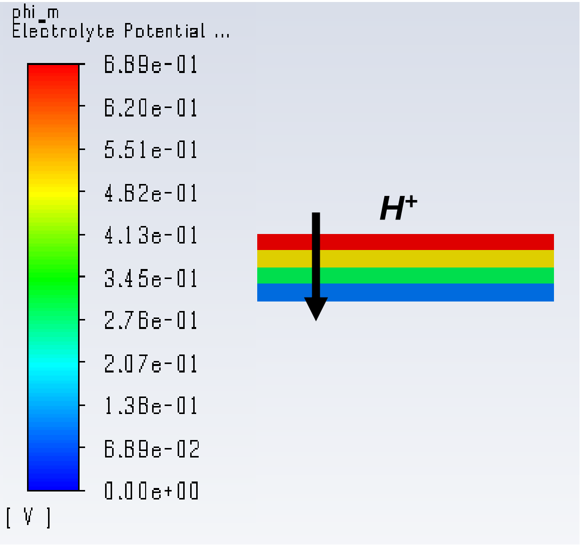


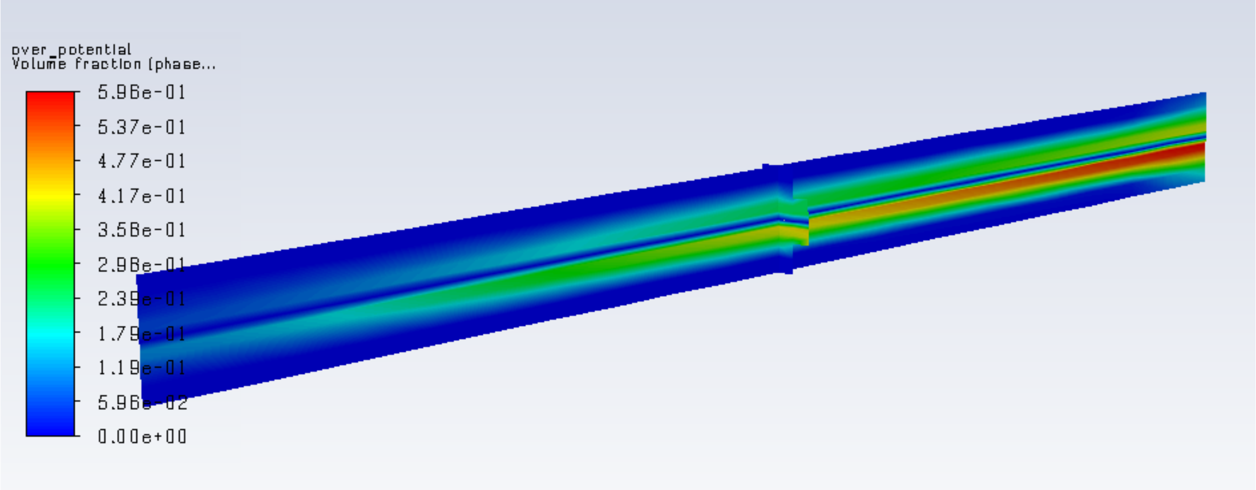


Green Hydrogen Production – PEM Electrolysis

- **PEM Electrolysis**
  - New method to model green hydrogen production through electrolysis with the proton exchange membrane (PEM) model (beta)
    - Multiphase modeling integrated with electrochemistry solver
    - Modeling of porous electrodes in high-temperature PEM electrolyzer
  - Meshing conformal/nonconformal meshing for complex electrolyzer geometries





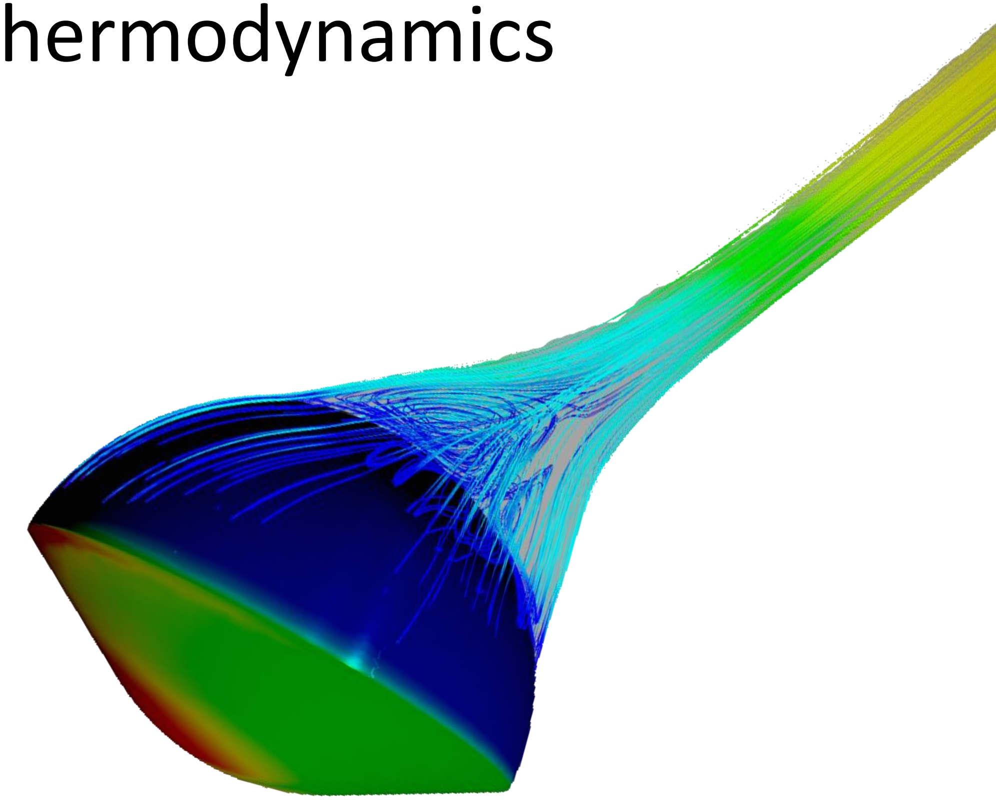


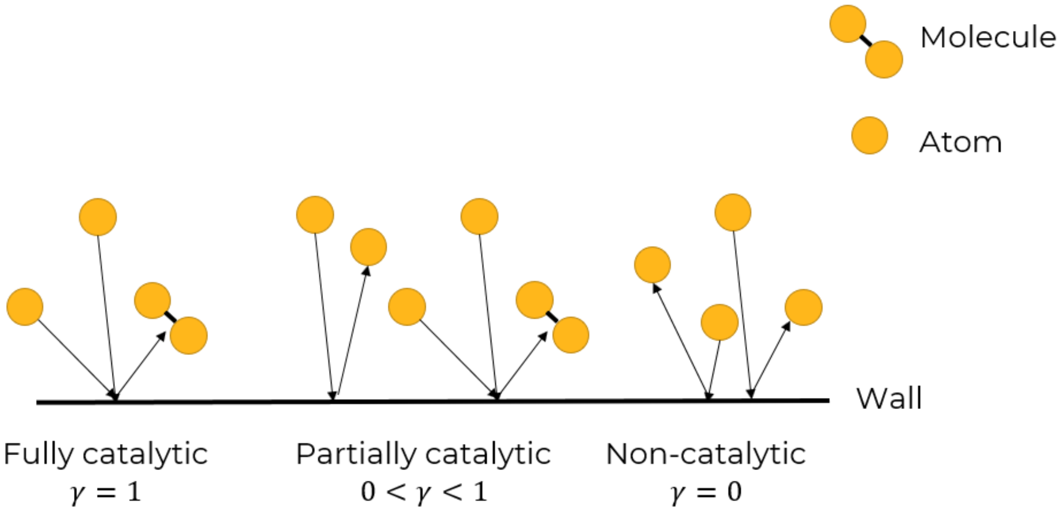
Gas phase volume fraction

Hypersonics

Improved Prediction of Hypersonic Aerothermodynamics

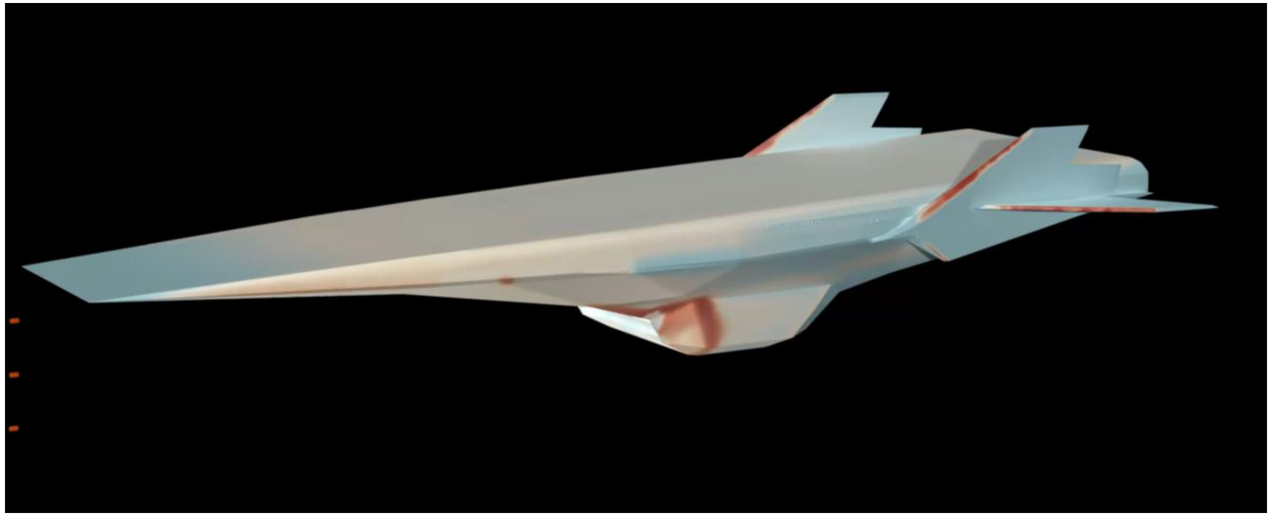
- **New "Partially Catalytic Wall" Boundary Condition Type**
  - Accounts for recombination of atoms near vehicle walls, which is common at hypersonic conditions
  - Improves predictions of species mixture composition due to reactions
  - Accurately predicts heat transfer to vehicle surface due to exothermic recombination reactions





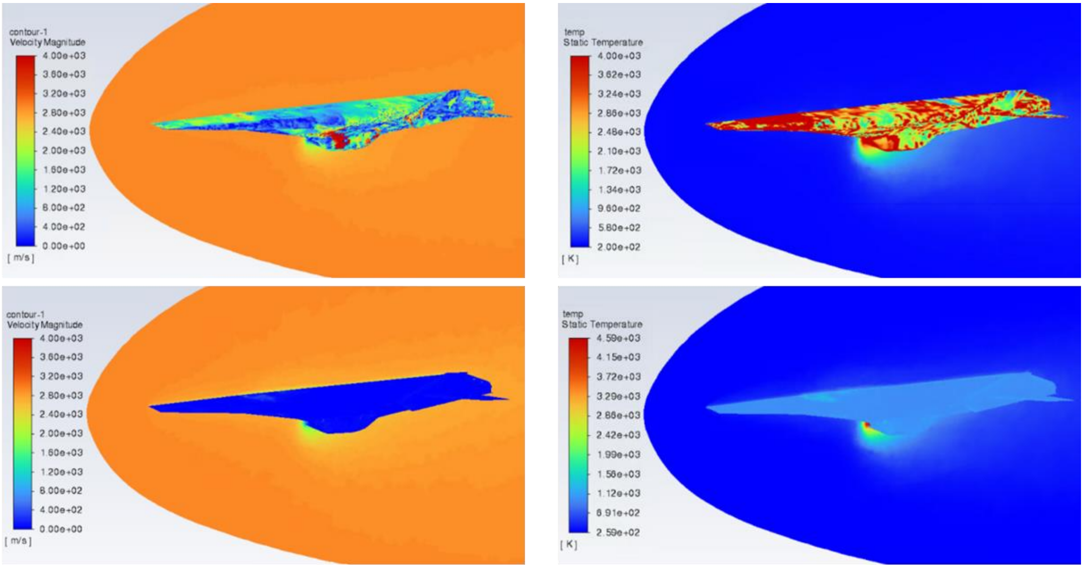
Improved High-Speed Flow Robustness

- **Improved numerical robustness for high-speed flows**
  - Enhanced CASM for highly stretched meshes
  - Improved high-speed numerics to stabilize the solution
  - Better initialization using viscous FMG initializer
  - Improved stability for hypersonic flows with thermodynamic and chemical non-equilibrium



Inviscid FMG

Viscous FMG

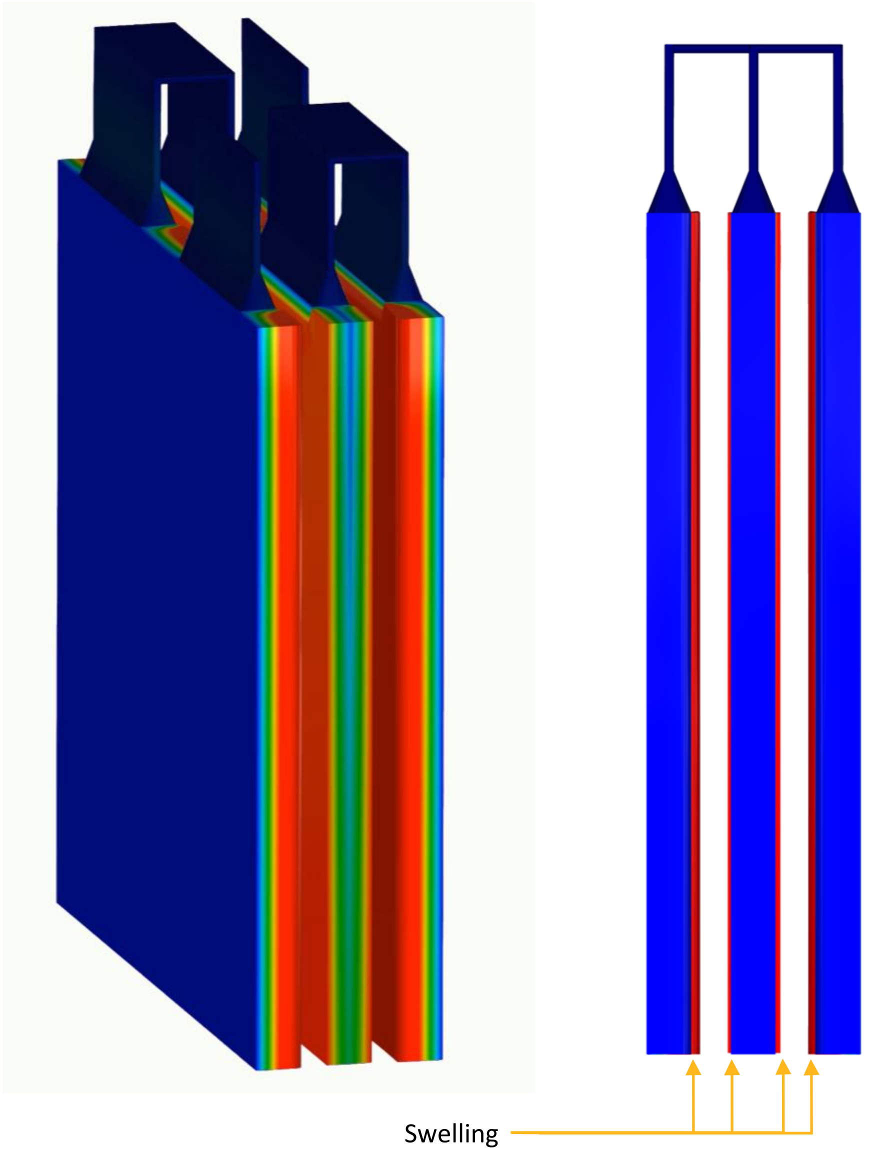


Velocity *Temperature*

Battery

Electrochemistry-based Battery Swelling

- **Battery Swelling Model**
  - Accurately predict battery swelling during charging due to electrochemistry, pressure and swell-related material properties
  - Swelling model couples Fluent's battery model and intrinsic fluid-structure interaction (FSI)
    - Battery model solves the electrode-level deformation
    - iFSI model solves the battery cell-level deformation



Battery Swelling Validation

- **LG G5 cell phone battery**
  - LiCO2 cathode/graphite anode
    - Anode: swell coefficient measured from experiment (~7%)
    - Cathode: swell coefficient from literature (1.8%)
  - Youngs Modulus of anode/separator/cathode = 46/50/56 MPa
- **Operating conditions**
  - Constant C-rate discharge: 1/3 – 1.2
  - External pressure: 0-15 MPa (0%-3% elastic strain)

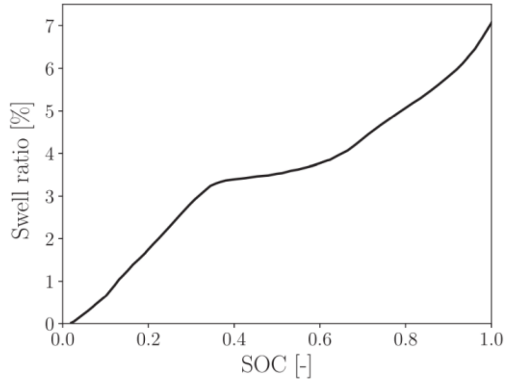
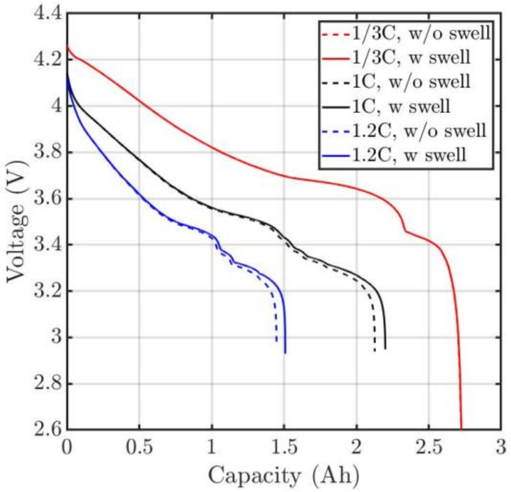
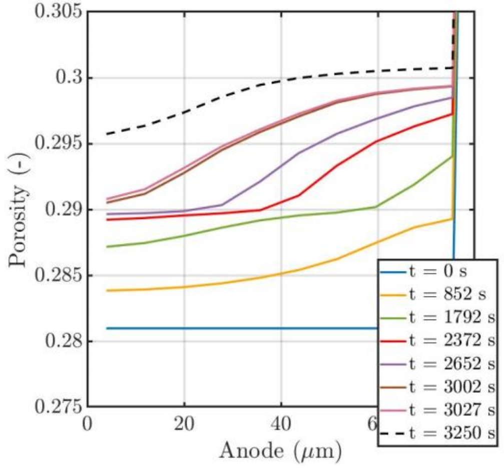


Figure 5. Measured thickness change ratio of Li_xC_6 during the delithiation procedure for a pouch cell that has a graphite volume fraction of 61 ± 1%.[51]

Fluent





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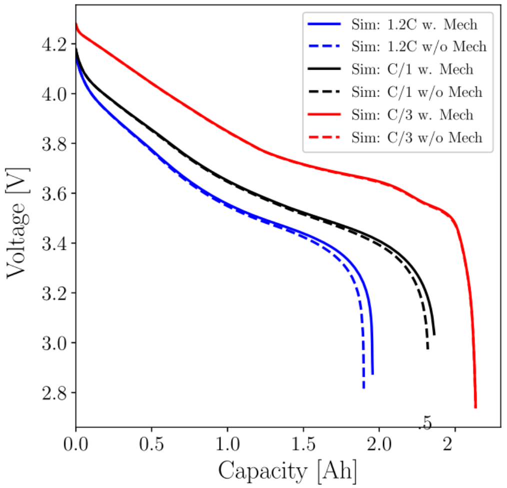

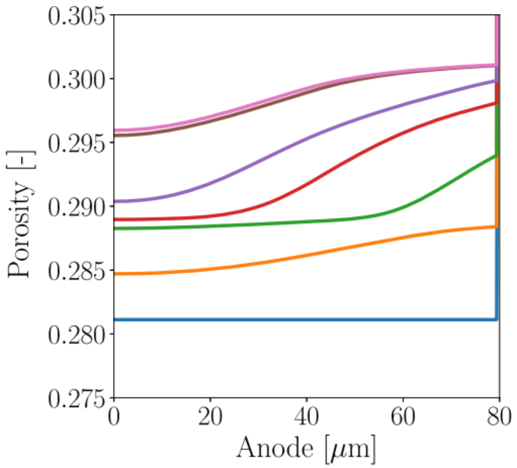

Xiaoxuan Zhang et al 2021 J. Electrochem. Soc. 168 02053

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