GRAPHICAL ABSTRACT:

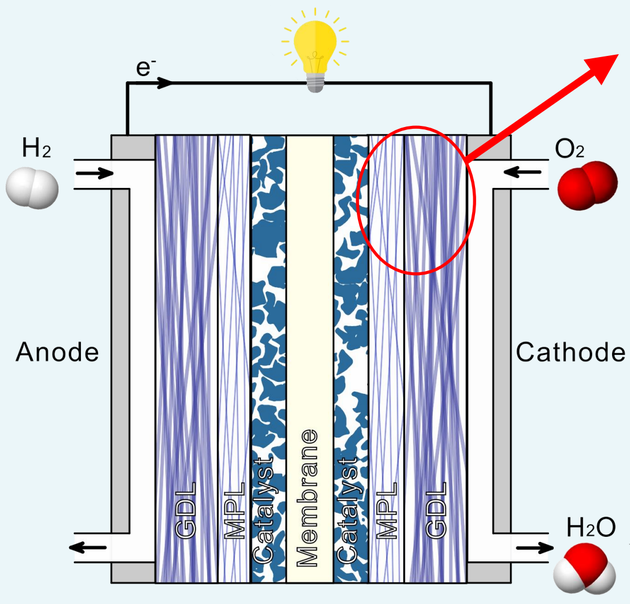
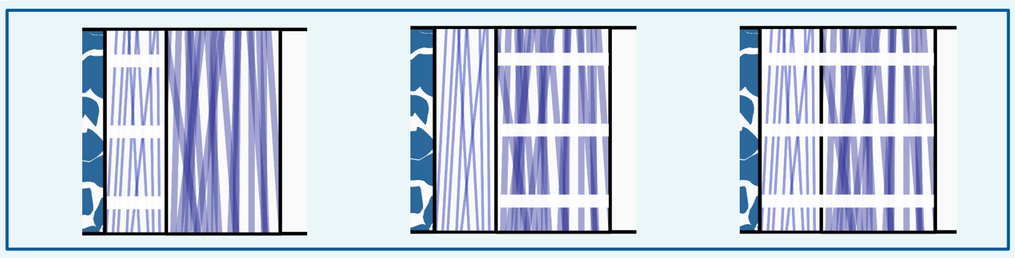


Fig. 1: PEMFC Diffusion Media (DM)

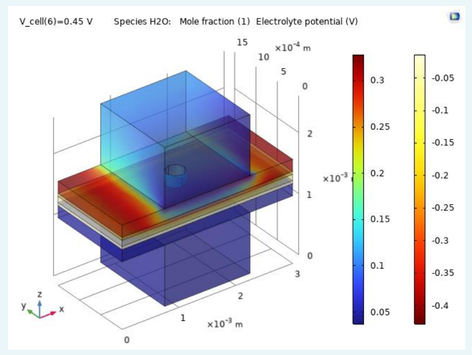


I Fig. 2: Investigation of different structural modifications: (GDL/MPL perforation)[1]

II Via computer simulations

COMSOL OpenFOAM

III Fig. 3: Performance metrics



IV Experimental Comparison, feedback, conclusions & improvements

1 ABSTRACT:

In polymer electrolyte fuel cells, water management poses a challenge, especially at the cathode for high current densities. Here, liquid water can obstruct gas flow and affect performance. [3].
The project aims to Improve Diffusion Media thereby enhancing the efficiency of fuel cells. To achieve this, the required know-how is provided by a network of academic and industrial partners.

2 RESEARCH OBJECTIVES

- optimize the water management at the cathode side of the PEMFC by using tailored structural modifications (laser perforations).
- model support for design and industry-scale fabrication of advanced gas diffusion layers.

3 METHODOLOGY:

Development of a multi-scale model, combining the structural level of the GDL material, a unit cell of a single perforation, with macroscopic cell performance.
This allows optimizing manufacturing parameters of material structure, laser perforation and cell design.
1- Data and parameters collection [4]
2- Development of the model:
- Perforation/alignment scenarios
- Local wettability adjustments

3- Performance investigations.

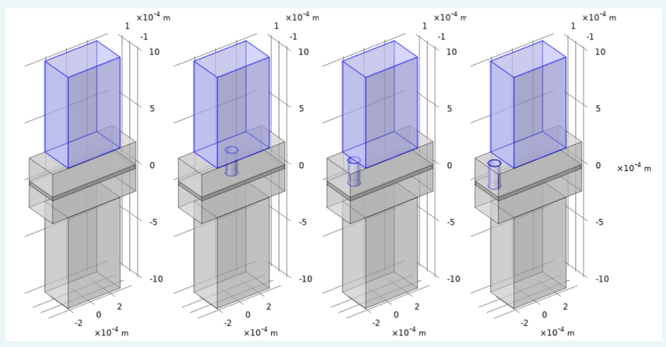


Fig. 4: Unit cell: DM modified PEMFC

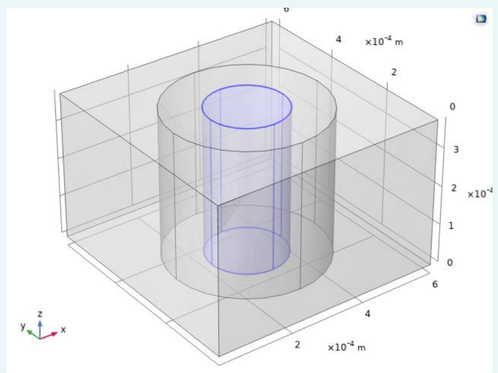


Fig. 5: Water behavior at pore size scale in the vicinity of a perforation

4 FIRST RESULTS

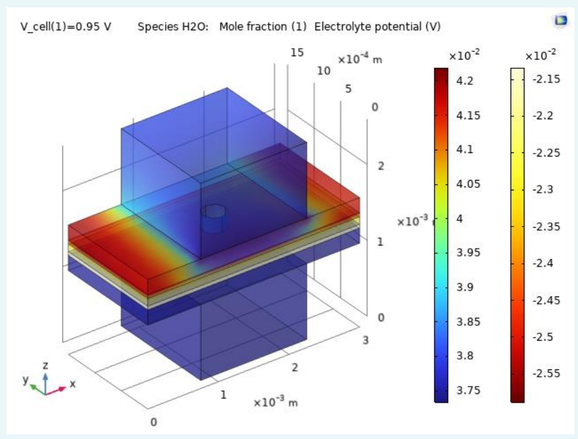


Fig. 4: H_2O Molar distribution in the GDL / Electrolyte potential

5 EXPECTED IMPACT

- understanding of the influence of structural changes on cell performance.
- optimized perforation patterns for large-scale fuel cell production.
- develop a predictive model to reduce costly manufacturing needs.

6 REFERENCES

[1] Geiger, Christian, et al. Procedia CIRP 111 (2022)
[2] Mishma S Stanislaus, et al. (2023)
[3] Alaswad, Abed, et al. Energies 14.1 (2020)
[4] Gerteisen, Dietmar, et al. Journal of Power Sources 195.16 (2010).
[5] (BMUB), Climate Protection Plan 2050 - Policy principles and goals of the Federal Government. Available: https://www.bmwk.de/Redaktion/DE/Publikationen/

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Impedia

Production of the microporous layer	Laser structuring	quality assurance
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