DELIVERING HIGH-QUALITY PEMS FOR ELECTROCHEMICAL APPLICATIONS

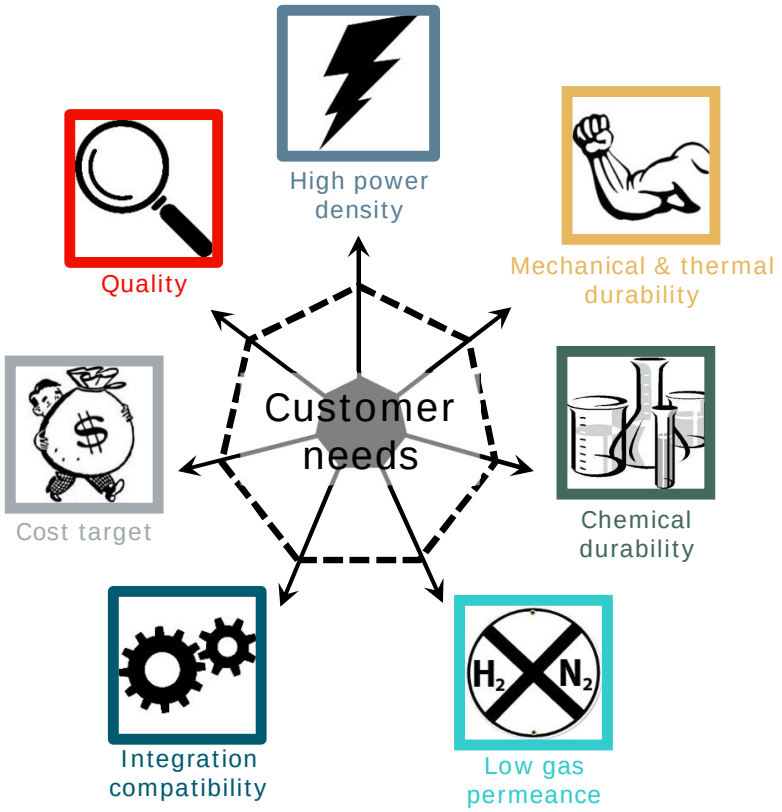
WL Gore

International QC Meeting on Fuel Cell & Electrolyzer MEAs
May 05 & 06, 2021

Together, improving life

Gore's vision for PEM industry

- Deliver the most valuable, reinforced membrane that meets high-volume market needs
  - Best balance of power density, durability, cost, and **quality**
  - Reliability & supply assurance
- To accomplish objectives
  - Strong, open relationship with automotive OEMs and other customers
  - Cultivate relationships with commercial ionomer manufacturers
  - Integral alignment of business model, R&D, and manufacturing with OEM needs



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Quality commitment: Detection and marking

Gore will remain at, or above, the state-of-the-art in performance and durability by developing new technologies to satisfy the evolving needs of the market, like cost reduction and quality-uniformity-reliability improvement.

Current status

- Online XY size inspection
- No online chemical analysis
- Batch sampling for iron

Future state

- Defect Z-height characterization
- Roll-to-roll inspection for iron contamination
- Spec for thickness assurance
- No pinholes
- Defect marking
  - Preferred method may depend upon the application method of the downstream electrodes

Gore investing to understand optimal future state.
Considering cost, volume, and fitness-for-use.

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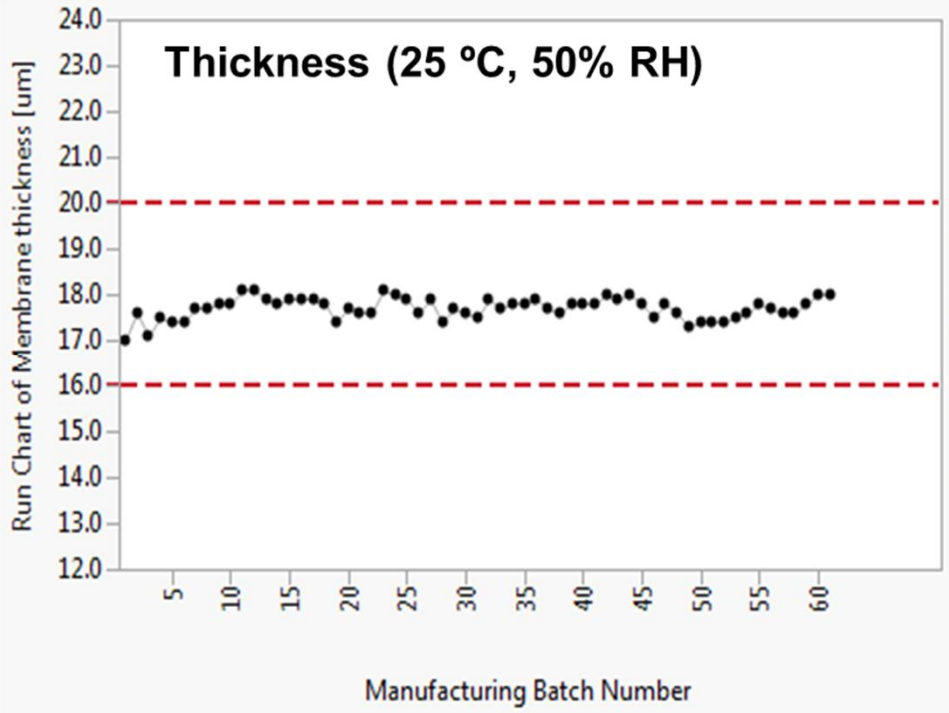
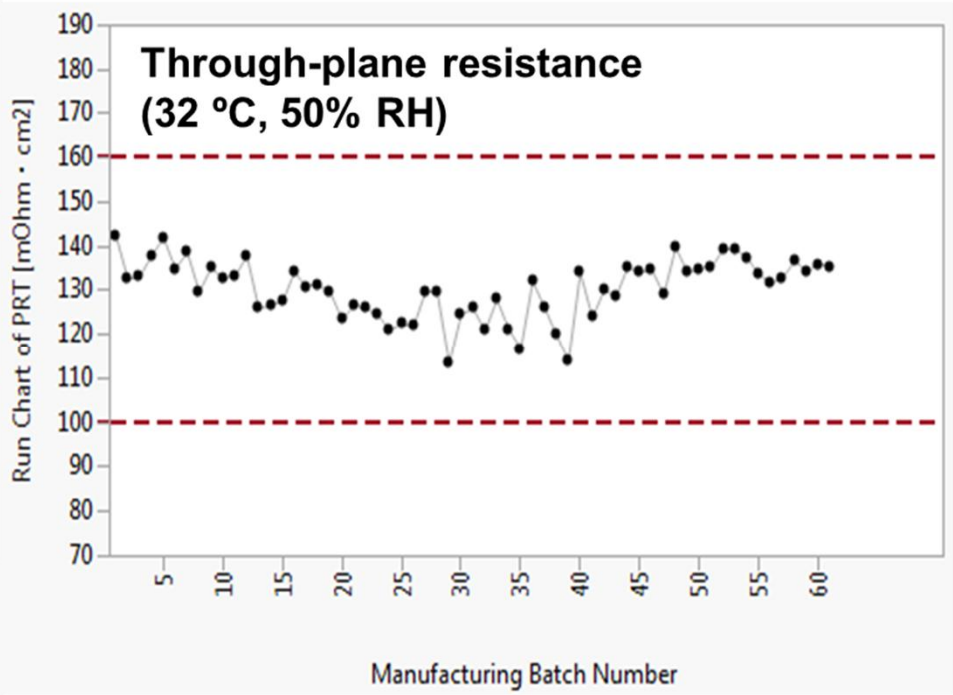
Internal quality monitoring metrics





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What is a defect?

Impact of MEA non-uniformities on membrane durability through X-ray computed tomography (XCT) characterization

- NSERC Grant in collaboration with SFU FCReL and Ballard Power Systems Inc.
- Goal: Develop detailed understanding of *potential* failure initiation points (ie non-uniformities)
- 3-year study including experimental and modeling approaches
- Utilizing nano and micro x-ray computed tomography capability

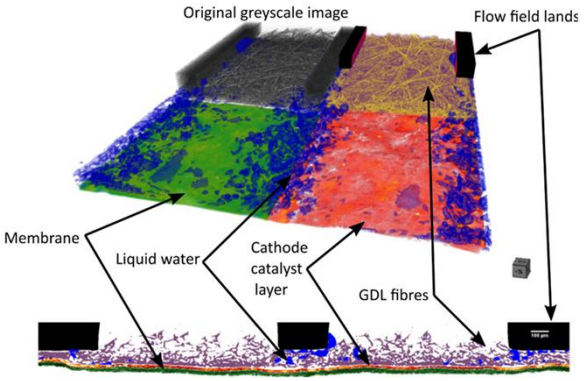
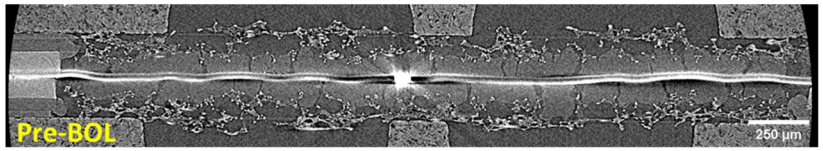


Image courtesy of
Dr. Erik Kjeang
Canada Research Chair in Fuel Cell Science and Technology Development
Link: fcrel.ca



XCT Image of foreign particle before testing
Nitish Kumar / Dr. Erik Kjeang

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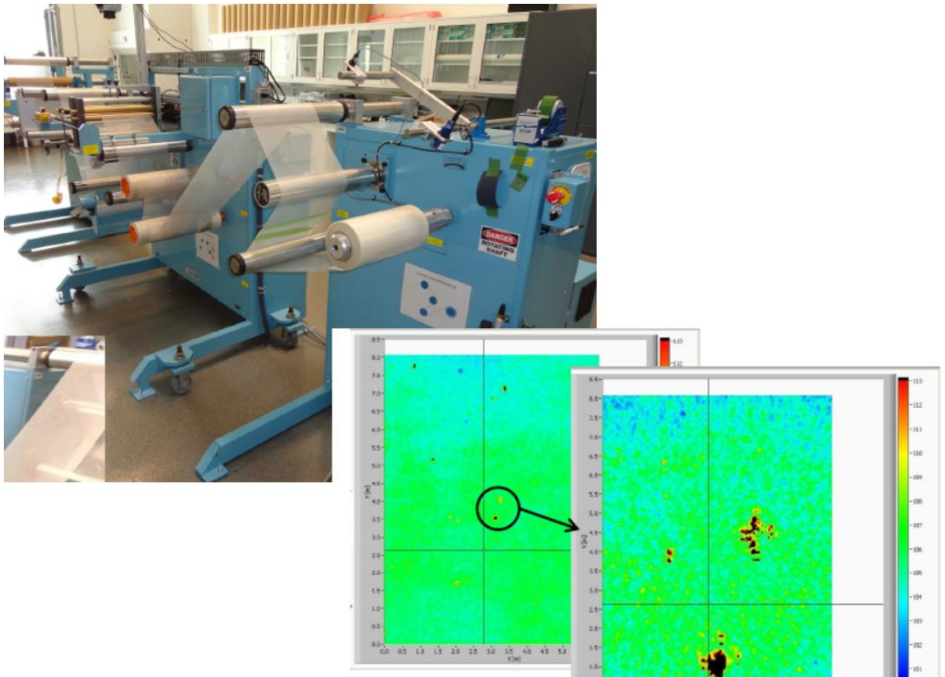
How to measure? Gore-NREL Collaboration

- Documenting defects with better precision
- Using NREL flat sheet and roll-to-roll inspection set-ups to detect non-uniformities ≥ 20um.
  - Particles
  - Scratches
  - Bubbles
  - Pinholes



Example of defect map

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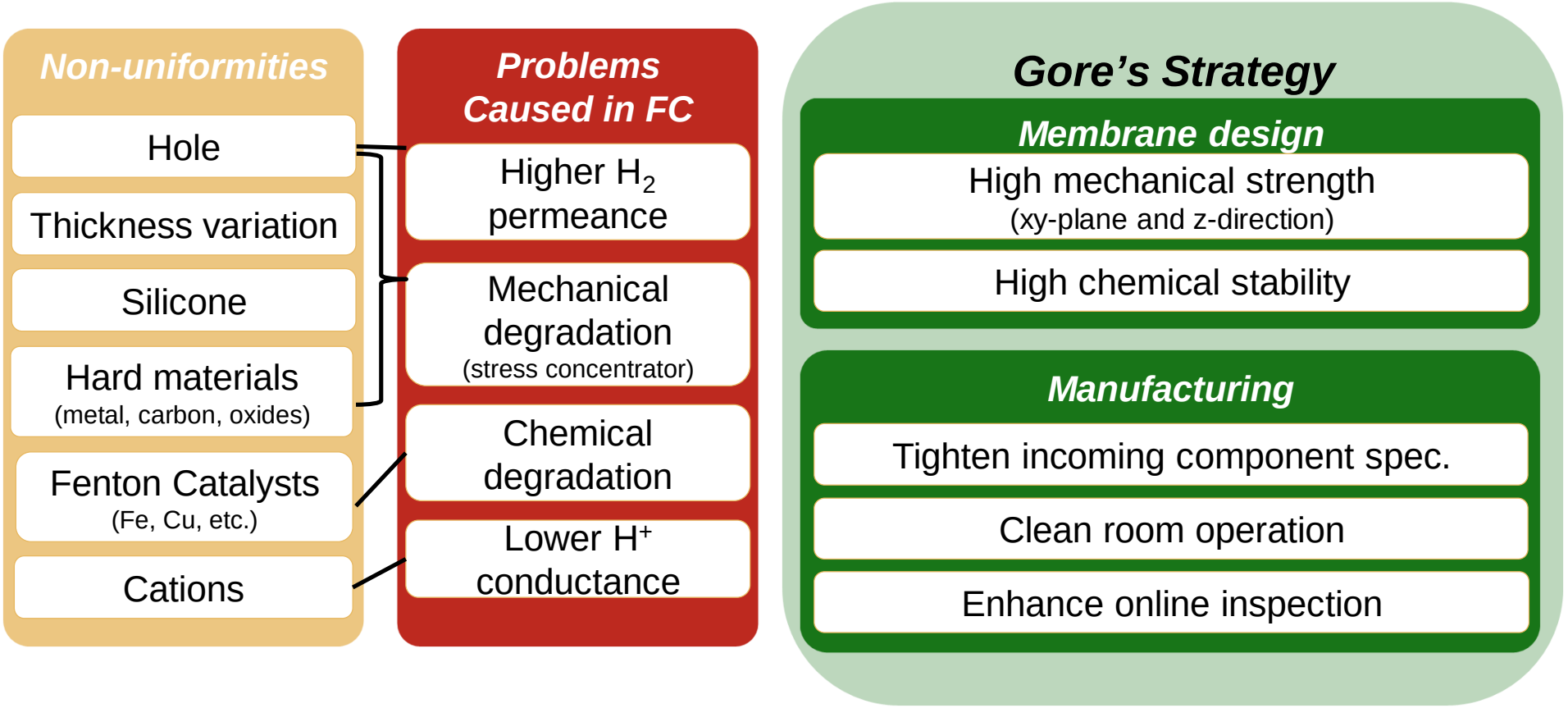
Reducing impact of non-uniformities



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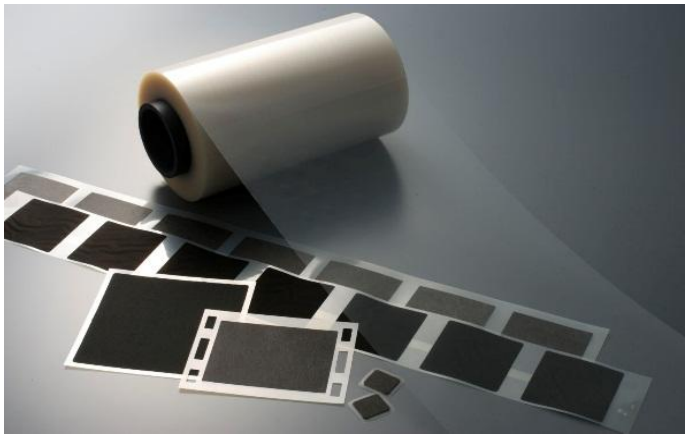
Summary

- Gore is committed to be a leading PEM supplier in global fuel cell market and adjacencies

  Deliver high-performance, durable, low-cost and high-quality PEMs for electrochemical applications

- Build on existing material and manufacturing platforms
- Focus for future work:
  - Understand meaningful targets for allowed defects
  - Identifying non-uniformities that impact fitness-for-use
  - On-line inspection capability



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