NANOMECHANICAL CHARACTERIZATION TECHNIQUES FOR FUEL CELL COMPONENT MATERIALS

FUEL CELL COMPONENTS OPTIMIZATION USING NANOMECHANICAL TESTING
Electrode Material or Catalyst Coated Electrode Membrane Material (Cathode & Anode) • Bipolar Plate Material & Coating
Electrolyte Membrane • Current Collector • Membrane Electrode Assembly (MEA) Interface Testing

QUANTITATIVE NANOSCALE MECHANICAL & ELECTRICAL PROPERTIES TESTING TECHNIQUE

- Hardness (H) Measurement (GPa, MPa, KPa) | Nanoindentation
- Delamination or Film Failure Testing (N, mN, µN) | NanoScratch
- Young’s Modulus (E) Measurement (GPa, MPa, KPa) | Nanoindentation
- Quantitative Wear Resistance Testing (N, mN, µN) | ScanningWear™
- Quantitative Adhesive Characterization (N, mN, µN) | Nanoindentation & NanoScratch
- Surface Morphology, Phase Separation & Roughness Measurement (nm, µm) | In-Situ SPM Imaging
- Dynamic Modulus & Stiffness (K) - storage (E') & loss (E'') (GPa, MPa, KPa) | nanoDMA® & Modulus Mapping™
- Nanoscale Electrical Conductivity (I-V) Measurements, Current Density Mapping, I-V Cycling | nanoECR®

PROCESS OPTIMIZATION
Efforts on reducing the cost of fuel cells are ongoing and newer materials and processing techniques are being explored as a promising approach. This will require further optimization of commonly used processing techniques such as calendaring for mass production of higher quality membrane, sintering, screen printing, tape casting and other coating techniques such as spin coating and spray coating for depositing optimally functional electrode materials with the right thickness. Nanomechanical testing is an established characterization technique with proven versatility and much needed sensitivity for such process optimization in the fuel cell industry, both in R&D as well as manufacturing.

HIGHLIGHTING FEATURES TO SUPPORT FUEL CELL RESEARCH

- **Fuel Cell Nanomechanical & Electrical Testing Package** is a Modular Design to Support a Variety of Testing Options:
  - In hydrated or non-hydrated conditions and at inert gas, sub-zero & higher temperatures.
  - **Advanced Controller**: Industry leading and offers superior feedback loop rate.
  - **nanoDMA**: Dynamic mechanical analysis at nanoscale.
  - **nanoECR**: Electrical contact resistance measurements at nanoscale.

- **Patented Transducer Technology**: Electrostatic actuation driven force & displacement sensor has low thermal drift and ultra low force & displacement noise floor to accurately determine quantitative mechanical (including coefficient of friction, scratch & wear testing for film failure & performance) and electrical properties of fuel cell component coatings & materials.

- **In-Situ SPM Imaging Combined with Piezo Automation**: Enables pre and post nanomechanical test morphological characterization with precise testing location selection & automation.

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**PUBLICATIONS & PATENT IN FUEL CELL RESEARCH INVOLVING NANOMECHANICAL CHARACTERIZATION**

2. "Microstructures and mechanical properties of Ce1−xGdxO2−γ (x = 0.05, 0.1, 0.2) with different sintering temperatures", Journal of the European Ceramic Society 30 (2010) 669–675.


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**HYSTITRON PRODUCT DETAILS**

Hysitron is the world leader in developing nanomechanical test instruments and continues to design cutting edge technology and testing solutions for the scientific community since 1992.

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**PI Series PicolIndenter®**

In-Situ Nanomechanics for TEM or SEM

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**TI Series TriboIndenter®**

Versatile Stand-Alone Nanomechanical Testing Platform

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In-situ SPM image showing a modulus map to determine dynamic (Storage & Loss) modulus across phase separated proton exchange membrane (PEM).

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**Note**: TriboScope® is available and a needed option for similar measurements with an AFM. Contact Hysitron for more information.

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