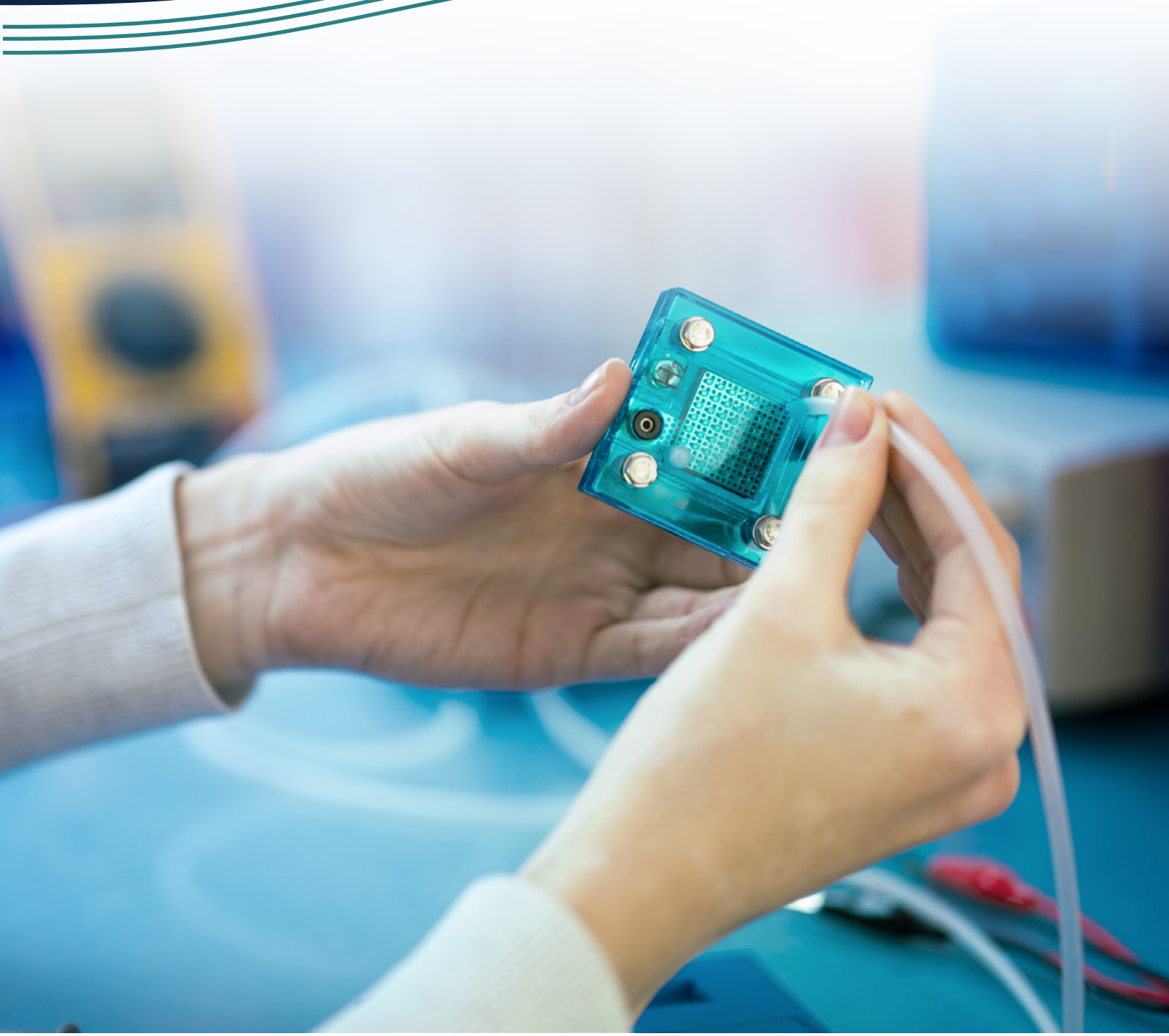
FUEL CELLS

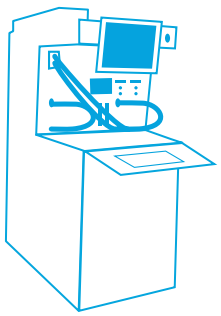


CERC
Clean Energy Research Centre

FUEL CELLS AT CERC

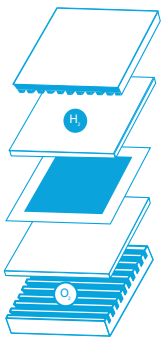
Fuel Cells are electrochemical devices that transform chemical energy into electrical energy. The uses of fuel cells range from small portable applications, through medium to large stationary power generation, to applications in the transportation sector.

Canada is a global leader in hydrogen and fuel cell research, development and commercialization. Canada is a large producer and user of hydrogen and home to a significant concentration of hydrogen and fuel cell expertise. The largest cluster of hydrogen and fuel cell companies in Canada is located in British Columbia, in which Clean Energy research Centre at the University of British Columbia has played a pivotal role from years of research, development and demonstration activities.



DIAGNOSTICS

New testing protocols to investigate the relationship between structure and function in fuel cell components (Gas diffusion layers, Catalyst layers, electrolyte).



MANUFACTURING

Fast and high throughput techniques for quality control and screening of fuel cell components.

COMPONENT OPTIMIZATION

Development and evaluation of novel catalytic materials for the fuel cell anode and cathode.

RESEARCH PROJECTS

Conventional electrochemical tools such as cyclic voltammetry and impedance spectroscopy will be used as basis to develop these new diagnostic methods and applied to study structural changes of the electroactive fuel cell components. Development of new accelerated stress test (AST), electrochemical, morphological, permeability and electrical conductivity diagnostic tools to study the degradation mechanisms of fuel cell components will also be addressed in this research. This research will use the state-of-the-art facilities in the Clean Energy Research Centre such as segmented fuel cell assemblies, 16 channel potentiostat and fuel cell test stations.

MANUFACTURING

Fast and high throughput techniques for quality control and screening of fuel cell components.

CERC is developing new online monitoring bench scale systems that allows for performing continuous layer quality tests. This research will incorporate traditional optical characterization as well as new techniques to characterize the fuel cell materials during the manufacturing process while addressing the industry demands.

CATALYST DEVELOPMENT

Development and evaluation of novel catalytic materials for the fuel cell anode and cathode.

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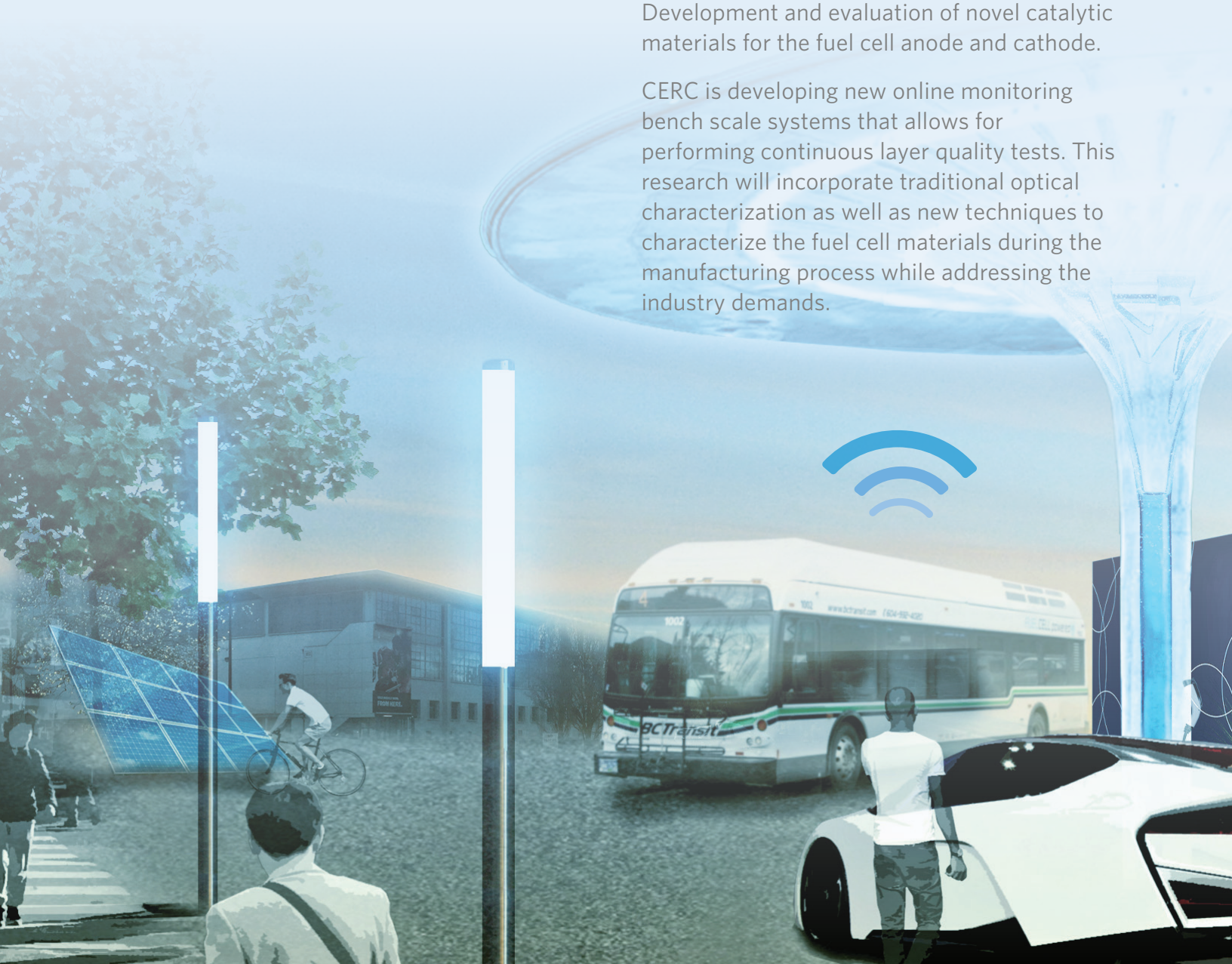


CHARACTERIZATION TOOLS

Novel characterization tools for the fuel cell materials such as surface wettability test apparatus, permeability apparatus, resistance measurement apparatus, etc.

The project looks into advancing the fundamental understanding of the fuel cell components by devising new approaches and developing new metrics.

VEHICLES

Design, development, demonstration and evaluation of the world's first fuel cell garbage truck. The truck will be deployed and tested as part of a fleet of municipal waste collection vehicles.

Deploying the truck at UBC will take advantage of the research, development and demonstration infrastructure and expertise at the University (secure wireless networks for telematics, enhanced consumer and early adopter feedback, fleet-integration, etc.). The truck platform will accommodate different applications (aircraft and container tractors, drayage vehicles, etc.) on a standardized chassis and powertrain design.

This project aims to demonstrate and evaluate critical use cases to better understand, in intimate detail, the barriers and opportunities for passenger vehicles.

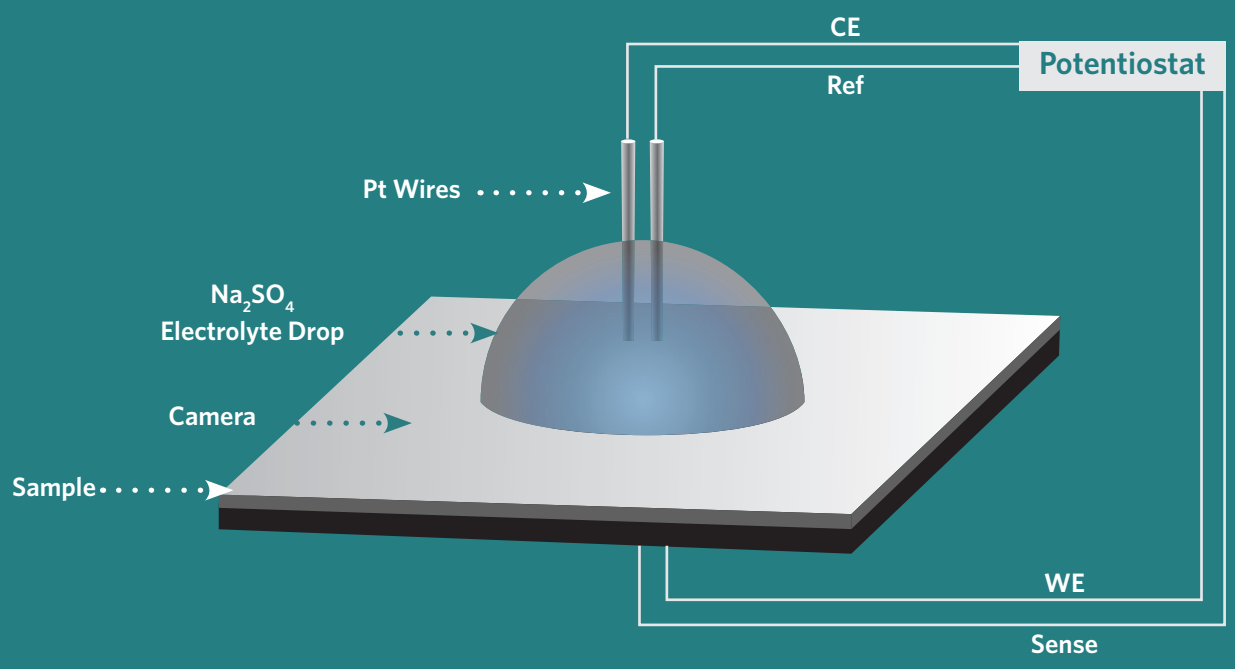
2015 marked a milestone in fuel cell and hybrid vehicle commercialisation: with new electric power-train vehicles entering the North American market. Continued success will increasingly depend on the ability to reach mass-market scales in a timely manner. By collecting vehicle telematics and owner experiences in real operating environments, we will be able to examine the impact of technology progress, specific user experience issues and develop new business models to ease transition dynamics.

FEATURE PROJECT

ELECTROCHEMICAL APPROACH TO EVALUATE THE WETTABILITY OF ROUGH SURFACES

Surface wettability is usually determined from the optical measurement of the contact angle of a droplet placed on the solid surface of interest. Theoretical models show that the contact angle depends on the solid-liquid interaction under the droplet, which is optically inaccessible. Here, we present an electrochemical method for evaluating the wetted area under a droplet sitting on surface with mechanically induced roughness feature. The method takes advantage of the electrochemical double layer capacitance, which can be quantified using electrochemical approaches such as cyclic voltammetry. The double layer capacitance is proportional to the ion-accessible solid-liquid interfacial area and therefore can be used as a characterization metric.

The experimental approach includes simultaneous measurement of the contact angle along with the capacitance, which allows subsequent correlation between the experimental results and the Wenzel and Cassie-Baxter wettability theories. We have shown the capability of this method for a series of carbonaceous surfaces with varying degrees of roughness. We believe this work has significant implications as a tool to characterize and to understand the wettability on rough surfaces as well as to facilitate the development of mechanistic and predictable mathematical models for surface wettability.



THE CERC ADVANTAGE

The Clean Energy Research Centre (CERC) comprises a unique and multidisciplinary team of researchers dedicated towards development and commercialization of the fuel cell technologies. CERC provides a unique environment to do cutting edge research and for collaborations with industrial partners that provides insights into the latest industry demands. The CERC offers access to unique opportunities and resources, including:

EXPERTISE

We bring together the experts from the fields of Mechanical Engineering, Chemical Engineering, Material Science, electrochemists and experienced researchers/executives from fuel cell industries.

CUTTING EDGE TECHNOLOGIES

CERC provides access to cutting edge technologies including state-of-the-art fuel cell testing platforms (Segmented cell, 16 channel electroanalysis system) and test stations. Also, the centre is actively involved in the development of newer technologies that can advance the fuel cell research initiatives.

STRONG PARTNERSHIPS

Connections to a diverse group of academic and industry partners help maximize both the relevance and impact of our efforts. Some of our partners include:

- Ballard
- Automotive Fuel Cell Cooperation (AFCC)
- Mercedes-Benz fuel cell (MBFC) Division
- Hydrogenics
- Greenlight
- Fraunhofer ISE
- HyPlat

CERC RESEARCH APPROACH

BREAKTHROUGH TECHNOLOGIES

- State-of-the-art fuel cell testing platforms (Segmented cell, 16 channel electroanalysis system) and test stations

SYSTEM SIMULATION MODELLING

- Modelling and simulation
- Validates technological benefits

PARTNERSHIPS + NEW VENTURES

- Commercialisation of research product(s)
- Work with existing partner companies, new start-ups, and licensing

EXPERIMENTATION + TESTING

- Bench and lab scale experiments
- Full-scale testing capabilities under development

THE UNIVERSITY OF BRITISH COLUMBIA
Clean Energy Research Centre

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