Martin County
Hydrogen Fuel Cell Development

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Microcell Corporation

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Project ID: fcp_13_bonner-stewart

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Overview

Timeline

- Start – March 1, 2008
- Finish – March 31, 2009
- 100% Complete

Budget

- Total project funding
  - DOE - $492,000
  - Contractor – $123,000
- Funding received in FY08
  - $446,914
- Funding received in FY09
  - $45,086

Barriers

- Barriers
  - Lack of High-Volume MEA Processes
  - Manual Stack Assembly
  - Lack of Manufacturing Processes for Balance of Plant Components for PEM Fuel Cell Systems

Partners

- Microcell Corporation
- Martin County Economic Development Corporation

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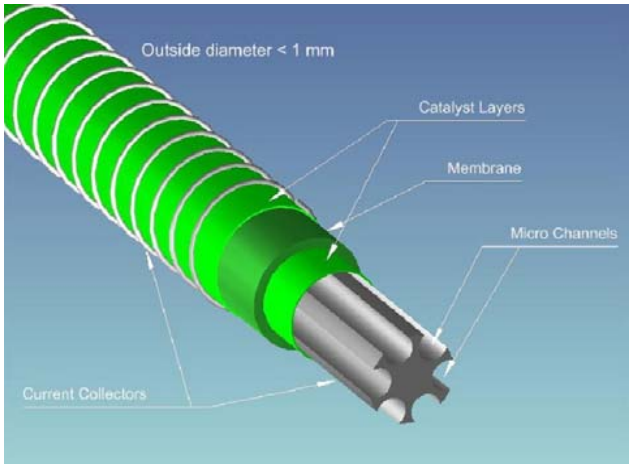
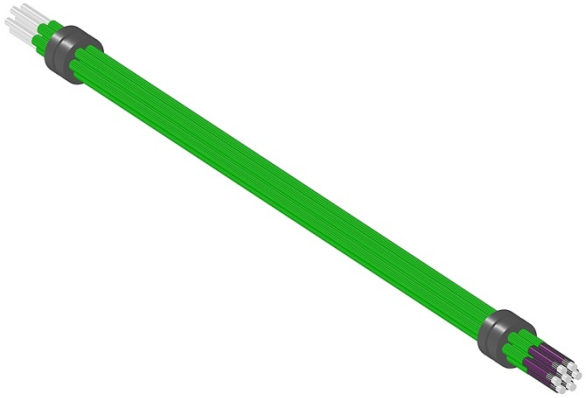
Microcell's Fuel Cell Technology

- With Microcell Corporation's patented technology, all the components of a single fuel cell, i.e., the electrocatalyst of cathode and anode, the polymer electrolyte membrane, and the current collectors, are extruded into a single microfiber ranging in size from 400 – 1000 microns in diameter.



- These microfiber PEM fuel cells are then bundled in parallel (Unicell) and connected in series to deliver power output in a variety of customized current and voltage output, shapes and sizes.



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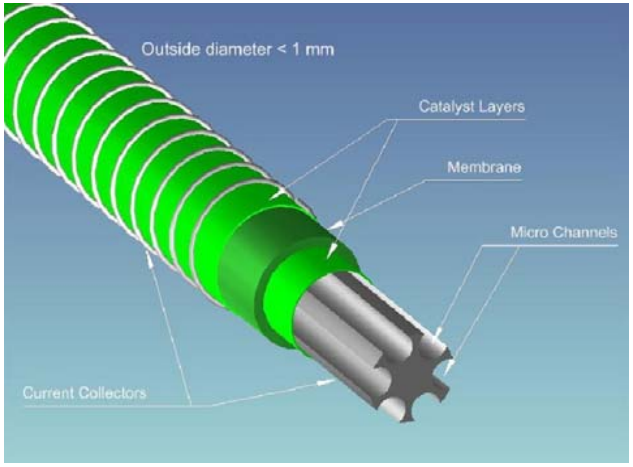
Relevance

- Objective:
  - To transfer a microfiber fuel cell technology's manufacturing process from a research and development level to a manufacturing environment and evaluate various parameters including production speed and product quality.
- Impact on barriers
  - Proven viability of the manufacturing process for "continuous manufacturing of multi-layer MEAs while maintaining critical performance properties" (DOE Multi-Year Research, Development and Demonstration Plan, Manufacturing Barriers, Section 3.5.5.A).
  - Proven viability of the Unicell manufacturing process as an "automated process for rapidly assembling fuel cell 'stacks' " (DOE Multi-Year Research, Development and Demonstration Plan, Manufacturing Barriers, Section 3.5.5.D).
  - Proven viability of the system simplification for "high volume manufacturing for balance of plant components and rapid assembly into the fuel cell power plant system for cost reduction" (DOE Multi-Year Research, Development and Demonstration Plan, Manufacturing Barriers, Section 3.5.5.E).

Technical Approach

Milestones	Progress Notes	% Complete
Task 1: Transfer extrusion manufacturing process from research and development to the manufacturing floor. 1.1 Extrusion equipment design 1.2 Equipment installation 1.3 Quality and performance evaluation	Equipment designed and installed. Viability of extrusion process for continuous manufacturing confirmed. 	100

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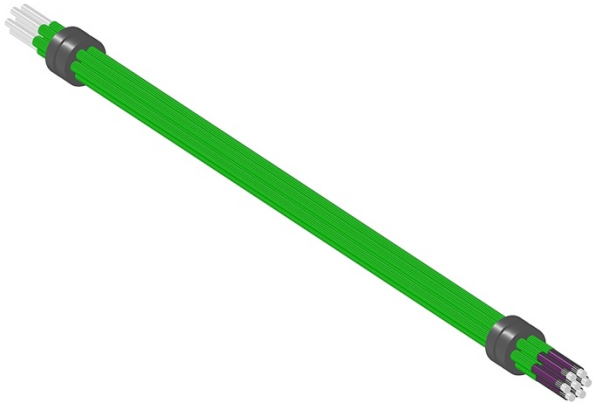
Technical Approach

Milestones	Progress Notes	% Complete
Task 2: Complete research and development on optimization of Unicell production. 2.1 Evaluation of process equipment to handle increased product processing 2.2 Quality and performance evaluation	Equipment designed and installed. Viability of automated “stack” assembly confirmed. 	100

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Technical Approach

Milestones	Progress Notes	% Complete
Task 3: Complete research and development on the effects of optimizing the fuel cell system assembly process. 3.1 Research and development on design and simplification of PEM fuel cell system for increased assembly speed 3.2 Evaluation of quality and performance	Design changes were identified which resulted in elimination of temperature controllers, valves and excessive humidification equipment resulting in significant system cost reductions. 	100

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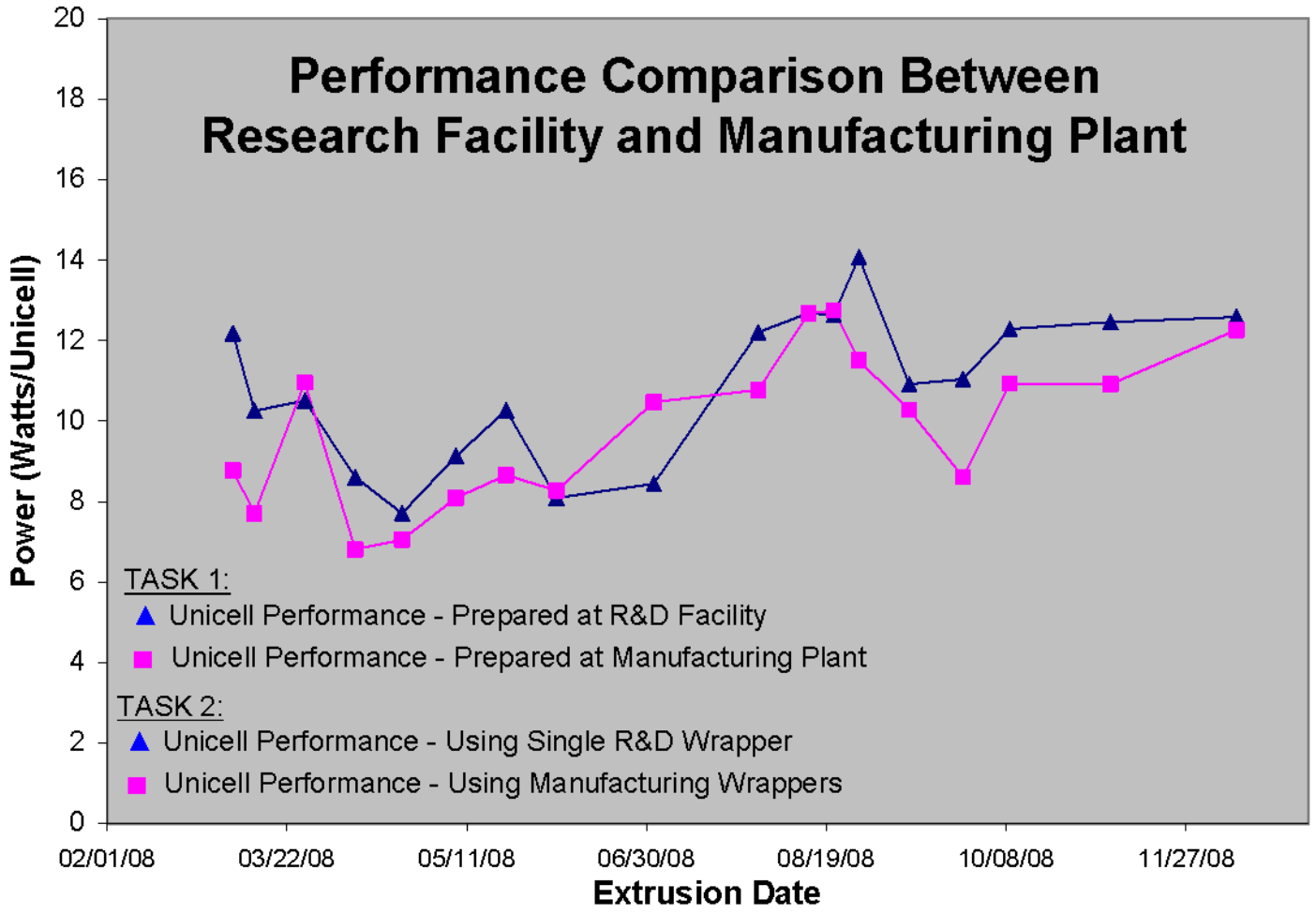
Technical Accomplishments and Progress

Task 1: Transfer extrusion manufacturing process from research and development to the manufacturing floor.

- Objective: Cell performance equivalent to R&D at manufacturing output.
- Task Measurement: Comparison of the power output of cells produced on the manufacturing line and those made in the research & development facility to verify that extrusion line production can be reliably duplicated at a manufacturing level.
- Results: Cells produced at manufacturing facility exhibited similar properties and performance characteristics close to those produced at R&D facility.
- Summary: Results show the viability of the manufacturing process for "continuous manufacturing of multi-layer MEAs while maintaining critical performance properties" (DOE Multi-Year Research, Development and Demonstration Plan, Manufacturing Barriers, Section 3.5.5.A).

Technical Accomplishments and Progress



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Technical Accomplishments and Progress

Task 2: Complete research and development on optimization of Unicell production.

- Objective: Increased Unicell fabrication.
- Task Measurement: Show increased throughput of Unicell production equipment (pieces/time) after enhancement and optimization with consistent Unicell performance (power output).
- Results: Unicell throughput was increased due to enhanced systems and programming without affecting Unicell performance.
- Summary: Results show the viability of the Unicell manufacturing process as an “automated process for rapidly assembling fuel cell ‘stacks’ ” (DOE Multi-Year Research, Development and Demonstration Plan, Manufacturing Barriers, Section 3.5.5.D).

Technical Accomplishments and Progress

Task 3: Complete research and development on the effects of optimizing the fuel cell system assembly process.

- Objective: System simplification.
- Task Measurement: Show reduction of balance of plant and simplification of operation procedures with minimal impact on module output power.
- Results: Several design modifications were identified and implemented that resulted in significant cost reductions and enhanced performance.
- Summary: Results show the viability of the system simplification for “high volume manufacturing for balance of plant components and rapid assembly into the fuel cell power plant system for cost reduction” (DOE Multi-Year Research, Development and Demonstration Plan, Manufacturing Barriers, Section 3.5.5.E).

Technical Accomplishments and Progress

Task 3:

Original Design	Modified Design
Electronically controlled coolant temperature controller	Eliminated
Valves and air flow controls for humidification	Eliminated
Fuel cell module, balance of plant, power electronics	Compartmentalized to allow for easy access, identified lower cost pumps and accessories

Collaborations

- Martin County Economic Development Corporation – Prime
- Microcell Corporation - Sub
- North Carolina State University – Technical assistance

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Proposed Future Work

FY09/FY10	Task 1	New membrane production processes have been developed at the R&D level and need to be transferred to the manufacturing facility to continue to increase cell performance.
FY09/FY10	Task 2	Textile machinery fabricators need to be contacted for the design and construction of industrial grade machinery.
FY09/FY10	Task 3	Design enhancements to electrical connections have been identified that will further enhance module performance.
FY09/FY10	Task 4	Extrusion line speed will be doubled to increase production efficiency.
FY09/FY10	Task 5	New catalyst formulation will be transferred from R&D level to manufacturing to further reduce cost.

Summary

Relevance	To transfer a microfiber fuel cell technology's manufacturing process from a research and development level to a manufacturing environment and evaluate various parameters including production speed and product quality.
Approach	Task 1: Transfer extrusion manufacturing process from research and development to the manufacturing floor. Task 2: Complete research and development on optimization of Unicell production. Task 3: Complete research and development on the effects of optimizing the fuel cell system assembly process.
Technical Accomplishments and Progress	Task 1: Transfer extrusion manufacturing process from research and development to the manufacturing floor. Results show the viability of the manufacturing process for "continuous manufacturing of multi-layer MEAs while maintaining critical performance properties" (DOE Multi-Year Research, Development and Demonstration Plan, Manufacturing Barriers, Section 3.5.5.A). Task 2: Unicell throughput was increased due to enhanced systems and programming without affecting Unicell performance. Results show the viability of the Unicell manufacturing process as an "automated process for rapidly assembling fuel cell 'stacks' " (DOE Multi-Year Research, Development and Demonstration Plan, Manufacturing Barriers, Section 3.5.5.D).

Summary

Technical Accomplishments and Progress	Task 3: Several cost saving designs were identified that resulted in significant cost reductions and enhanced performance. Results show the viability of the system simplification for “high volume manufacturing for balance of plant components and rapid assembly into the fuel cell power plant system for cost reduction” (DOE Multi-Year Research, Development and Demonstration Plan, Manufacturing Barriers, Section 3.5.5.E).
Collaborations	Martin County Economic Development Corporation – Prime Microcell Corporation - Sub North Carolina State University – Technical assistance
Proposed Future Work	Task 1: New membrane production processes have been developed at the R&D level and need to be transferred to the manufacturing facility to continue to increase cell performance. Task 2: Textile machinery fabricators need to be contacted for the design and construction of industrial grade machinery. Task 3: Design enhancements to electrical connections have been identified that will further enhance module performance. Task 4: Extrusion line speed will be doubled to increase production efficiency. Task 5: New catalyst formulation will be transferred from R&D level to manufacturing to further reduce cost.