

## Microcell Corporation

### Introduction

What began as an idea nearly a decade ago is now a flagship example of a new generation of manufacturing in North Carolina. During October 2007, Martin County became the home of Microcell Corporation's pilot manufacturing facility. The facility, located in a building formerly used for manufacturing custom packaging cartons, is expected to employ 100 local people to be trained by the nearby Martin Community College<sup>1</sup>.

The idea of company founder Ray Eshraghi was as risky as it was innovative. Not only does Microcell Corporation produce a new technology that has yet to prove its marketplace worth, but the company also produces this technology using a revolutionary design that could change the direction of their entire industry's development.

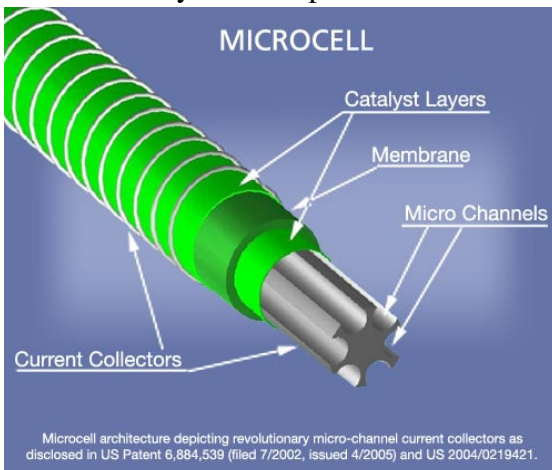


Fig. 1 – Design of the Microcell™

The emergence of Microcell Corporation's concept into the marketplace is no fluke. The company's path to the brink of commercialization is a testament to the economic development capabilities of a state ranked as having the

<sup>1</sup> <http://www.martin.cc.nc.us/>



### Company Snapshot

Microcell Corporation  
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<http://www.microcellcorp.com>

### Current Operations

R&D Facility/Headquarters in RTP  
Manufacturing facility in Robersonville, NC

### Overview

- Spun out of Advanced Energy, Inc.
- Incorporated in 2000
- Major investors include PEPCO, Duke Energy, Progress Energy, Dominion Electric, and N.C. Electric Membership Corp.
- Holds 11 U.S. Patents
- Grand Opening of manufacturing facility in Oct. 2007

### Awards & Grants

\$2.4 million federal ATP grant, 2001-2004  
2005 Frost & Sullivan Tech. Innovation  
2005 FuelCell South Crystal Flame Award

### Summary

Microcell Corp. is a N.C.-founded venture that develops and manufactures an innovative fuel cell polymer that can be integrated as a power source into applications ranging from residential to automotive and portable electronics.

“Top Business Climate” since 2005 and for six of the last seven years by Site Selection magazine<sup>2</sup>. The idea of a Microcell™ was developed at Advanced

<sup>2</sup>

[http://www.governor.state.nc.us/News\\_FullStory.asp?id=4243](http://www.governor.state.nc.us/News_FullStory.asp?id=4243)

## Ideas to Market: Case Studies of Renewable Energy Manufacturing in North Carolina

Energy, North Carolina non-profit funded through a small charge on electricity bills.

The idea was nurtured with a grant from the National Institute of Standards & Technology (NIST) Advanced Technology Program (ATP), and the company grew with support from an investor list including PEPCO Energy, Duke Energy, Progress Energy, Dominion Power and the North Carolina Electric Membership Corporation (NCEMC). The company's flagship Microcell™ product will be produced by workers trained via the N.C. Community College System's New & Expanding Industry Training program (NEIT) and demonstrated in a national program with assistance from the NCEMC.

### Company Profile

Microcell Corporation is a developer and manufacturer of fuel cell micro-fibers. The company was formed in 2000 to commercialize a unique fuel cell design based on a cylinder instead of a flat plate. The company operates a 12,000 ft<sup>2</sup> headquarters/R&D facility in the Research Triangle Park area of North Carolina, and an 80,400-ft<sup>2</sup> manufacturing facility in Robersonville, N.C.

The company uses an extrusion process to produce a microfiber fuel cell core for emission-free electricity generation that can be bundled like a textile. Although the company has the capability to produce the world's smallest fuel cell, they are currently focused on serving markets for buildings and other stationary power needs and automotive applications.

Microcell Corporation's technology has been recognized in several venues. In addition to a three-year federal grant, the company was also recognized nationally

as the recipient of Frost & Sullivan's 2005 Technology Innovation Award and regionally as the 2005 recipient of FuelCell South's Crystal Flame Award for

### Fuel Cell Structures And Assemblies

U.S. Patent 7,229,712

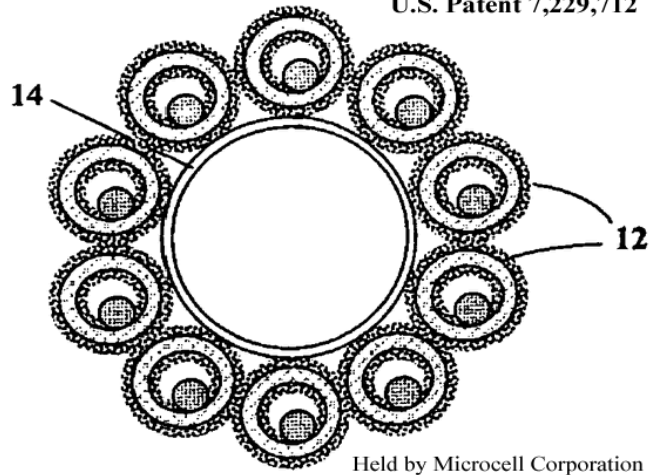


Fig. 2 – Patent filing image of technology

Entrepreneurship<sup>3</sup>.

In addition to the company's current 11 U.S. patents Microcell Corporation also holds six international patents. The company's trademarked Microcell™ product will undergo its first field test in a North Carolina residence via the Cooperative Research Network, a service of the National Rural Electric Cooperative



Fig. 3 – Robersonville, N.C. 80,400 sq.-ft. manufacturing facility

Source: Microcell Corp.

<sup>3</sup> <http://microcellcorp.com>

Association.

## **Technology**

The Microcell™ technology is an advanced extrusion-based polymer electrolyte membrane (PEM) fuel cell. Using hydrogen and oxygen, fuel cells produce electric power via an electrochemical reaction similar to a battery, but unlike a battery a fuel cell can operate indefinitely as long as fuel is supplied. Fuel cells are an emission-free technology that can be scaled to provide electricity for uses as small as a cell phone or as large as a neighborhood.

Microcell Corporation's technology is a literally a bundle of innovation, essentially a fuel cell with a twist. Their novel fuel cell design incorporates all the separate components of the standard fuel cell 'sandwich' into a string-like micro-scale polymer fiber. When Microcell™ fibers are bundled in parallel and connected in series circuits the product can serve a wide array of applications providing customized current and voltage output, as well as unconventional shapes and sizes.

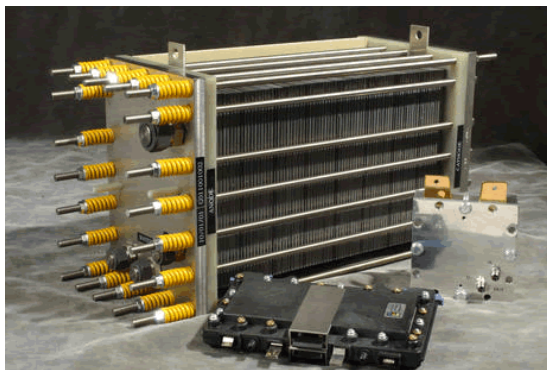


Fig. 4 – Typical PEM-type fuel cell 'stack' design.

Source: NREL PIX

A typical PEM-type fuel cell is made of flat layers that broadly include the

membrane, cathode and anode catalyst layers, and a current-carrying layer. These flat layers are assembled like a sandwich to form the 'membrane electrode assembly', or MEA. To attain greater power output MEAs are connected together and collectively called the fuel cell stack. In the traditional configuration, MEAs are hand assembled into stacks, and repairing a single MEA typically requires near-disassembly of the entire fuel cell stack.

Microcell's design innovation incorporates the function of the membrane, cathode catalyst, anode catalyst, and electric-conduction layers into a single fiber that is 500-1000 micrometers thick<sup>4</sup>. When bundled together, the fibers can be custom-made to meet a variety of customer needs, including shape, size, and power output. The bundled micro-fiber design is anticipated to enable Microcell™ fuel

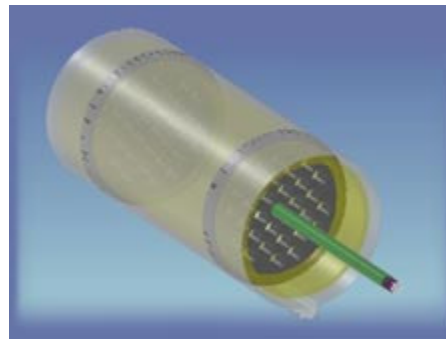


Fig. 5 – The Microcell™ cylindrical fuel cell design.

Source: Microcell Corp.

cells to operate with greater reliability, lower maintenance costs, easier repair, and higher product-design flexibility than traditional fuel cell designs.

<sup>4</sup> <http://microcellcorp.com/MicrocellCorp.pdf>

## Ideas to Market: Case Studies of Renewable Energy Manufacturing in North Carolina

By reducing production costs through the use of an automated extrusion process, the company aims to transition fuel cell technology into a commodity-like product. In addition to cost advantages, the Microcell™ fuel cell also addresses technical challenges common to fuel cells by incorporating resistance to carbon monoxide poisoning, and further reduced cost by providing a high power density because of its design's high ratio of surface area to volume – a feature of its cylindrical design.

In acknowledgement of the breakthrough potential the company's technology represents, Microcell Corporation received a \$2 million grant from the Advanced Technology Program (ATP) of the National Institute of Standards & Technology (NIST), a high-risk research investment matching program<sup>5</sup>.

*“In a three-year project, the company will develop, demonstrate, and test 1-5 kilowatt (kW) fuel cells that offer a power density of at least 400 watts per liter, with an ultimate cost target below \$100 per kW. In a microcell, gaseous or liquid fuel passes through a channel within the fiber...The inner and outer shell of the fiber is coated with an electrocatalyst.” – ATP Project Brief (No. 00-00-4429)*

### Summary

While Microcell Corp. is founded on an idea so innovative that it could revolutionize a technology that is itself only entering the earliest phases of commercialization. Microcell Corp.'s history exemplifies what is 'right' about technology-based economic development in North Carolina.

<sup>5</sup> The Advanced Technology Program of NIST was discontinued with the signing of the 'America COMPETES Act' (H.R. 2272) on August 9, 2007.

Spun out of a North Carolina non-profit, the company's founders landed in the fertile technology development

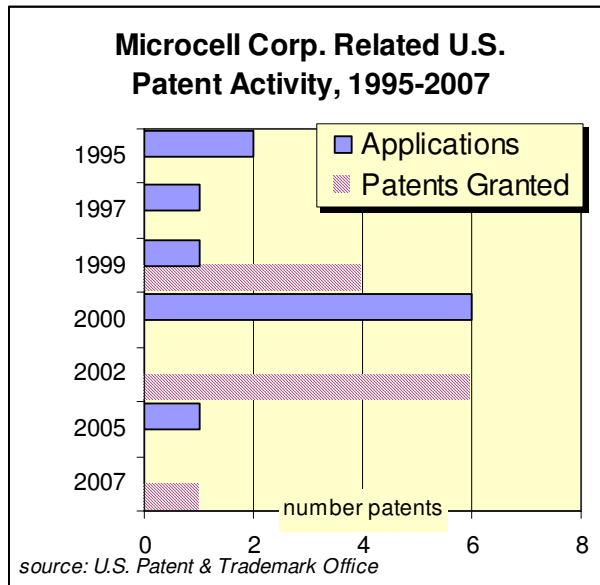


Fig. 6 – Patent filings and awards related to Microcell Corp. technology

environment around Research Triangle Park. The proof of Microcell's radical technology was funded through a Federal grant program tailored to support technologies so disruptive that the risk is matched only by the potential benefits to society.

The novel design of a power-generating textile was, in part, made possible with contributions from expertise found in the state's University system. With a proven technology at the ready, the company called upon the state's Community College system to provide a trained workforce.

Technology companies such as Microcell Corp., require more than ideas and knowledge to start making products – they require funding. In Microcell Corp.'s situation, funding could not have come from a more strategic source than North Carolina's three investor-owned utilities and the NCEMC – a group of potentially major end-users of fuel cell technology.

***Appendix A – Microcell Corporation Development Timeline***

| Date   | Event           | Title  |
|--------|-----------------|--|
| Oct-95 | Patent          | Initial Patent Applications  |
| Jun-97 | Patent          | Patent Application   |
| Mar-99 | Patent          | Patent Application   |
| Jun-99 | Patent          | Initial Patent Granted   |
| Jul-99 | Patent          | Patent Granted   |
| Nov-99 | Patent          | Patent Granted   |
| Dec-99 | Patent          | Patent Granted   |
| Jan-00 | Incorporation   | Microcell Incorporated   |
| Feb-00 | Trademark       | Trademark Application for 'Microcell'  |
| Jul-00 | Patent          | Patent Applications  |
| Nov-01 | Grant Funding   | Start of Project Period for NIST ATP grant   |
| Jun-02 | Investment      | Investment by PEPCO Holdings, Inc.   |
| Dec-02 | Patent          | Patent Granted   |
| Mar-05 | Patent          | Patent Applications  |
| Apr-05 | Conference      | Company president speaks at 7th Annual Small Fuel Cells Conference held in Washington D.C.<br>Receives FuelCell South Crystal Flame Award for Entrepreneurship |
| May-05 | Award           |  |
| Jul-05 | Trademark       | Trademark Granted for 'Microcell'  |
| Nov-05 | Executive       | Hiring of high-profile Chief Financial Officer   |
| Dec-05 | Investment      | \$1 million investment   |
| Jan-06 | Award           | Receives Frost & Sullivan 2005 Technology Innovation Award   |
| Jun-06 | Conference      | Microcell presents at Fuel Cell 2006 conference in Raleigh, NC.  |
| Jul-06 | Investment      | NC Electric Membership Corp. announces investment  |
| Jul-06 | Tech. Milestone | Microcell Announces Commercialization Milestone  |
| Jan-07 | Tech. Milestone | Microcell delivers its first automotive fuel cell core   |
| Feb-07 | Manufacturing   | Microcell Announces Manufacturing Facility   |
| Jun-07 | Patent          | Patent Granted   |
| Aug-07 | Investment      | Dominion Power Announces Investment  |
| Sep-07 | Product Demo.   | Residential Demonstration Announced  |
| Oct-07 | Manufacturing   | Manufacturing Facility Ribbon Cutting  |