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Article URL: http://www.smalltimes.com/document_display.cfm?document_id=4885

Power Chips: Flipside of cooling device could turn heat into juice
By Jack Mason
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Oct. 24, 2002 – Developers of a cooling technology that coaxes electrons to make a quantum leap across a 10-nanometer gap say they are "significantly ahead of schedule" on a product that works in reverse. The company's Power Chip aims to turn waste heat from a vehicle's exhaust system, geothermal source or smokestack into electricity.

Power Chips plc and Cool Chips plc are both subsidiaries of publicly traded Borealis Exploration Ltd., a former mining company with headquarters in Gibraltar and principal research facilities in the former Soviet Union.

The company said that in the lab, a test version of its Power Chip exposed to a heat source has produced a small flow of electricity across the nanoscale gap inside the device's thin "sandwich."

Solid-state thermoelectric devices have been investigated for years, but haven't yet surmounted the commercial challenge of converting heat into electrical energy efficiently. With the help of nano-engineered materials and structures, the prospects for low-cost, high-output thermal devices like Power Chips' may be getting warmer.

Last October, scientists at the Research Triangle Institute in North Carolina reported on a thin film that delivered a dramatic improvement in thermoelectric cooling. RTI said its nanoscale materials were 2.4 times more efficient and 23,000 times faster than any other known thermoelectric compounds.

The Defense Advanced Research Projects Agency (DARPA) and the Office of Naval Research have funded RTI's thermoelectric work since 1993. Last year RTI won a DARPA grant to develop a thermoelectric power device that, like the Power Chip, is intended to generate electrical power from heat sources.

Isaiah Cox, president of Cool Chips and Power Chips, said the company was invited by General Motors Corp. to exhibit its technology at the Global Powertrain Congress in Ann Arbor, Mich., the last week of September. One potential large-market

application for Power Chips is converting heat from exhaust systems into electricity.

Capturing the thermal energy in exhaust systems could eliminate the belts, pulleys and alternators needed to run a vehicle's electrical systems. Engines free to use more of their power to drive the vehicle would get better mileage, and smaller, lighter engines could do the work of larger ones.

The company is also touting its Power Chip for exploiting geothermal power – the heat from the earth in hot springs and geological faults. Cox said that Power Chips could extract electricity from even relatively cool geothermal sources of 200 degrees Fahrenheit or recoup waste heat from smokestacks and other industrial sources.

The output from prototype Power Chips is not yet high enough for commercial production, but Cox said the company has solved the major technical hurdles to achieving those levels. To extract maximum current, the gap inside the device must be very precise and the facing surfaces very smooth. According to Cox, that work has been successful.

"Achieving the goal of working devices has only one stage remaining: integrating the thin film materials layer between the electrodes," he noted.

Analyst Cronin Vining of ZT Services in Auburn, Ala., isn't yet convinced that Power Chips or Cool Chips will be as efficient as the company projects.

Vining, former president of the International Thermoelectric Society, noted that Borealis hasn't produced any scientific papers or experimental data to back up their claims of reaching 70-80 percent Carnot efficiency (compared to the 50 percent efficiency of conventional cooling systems.)

"I don't have any real theory or experiment to look at," said Vining, a physicist who has worked on thermoelectric materials at General Electric Co. and the Jet Propulsion Laboratory. Power Chips has presented "just ideas and some progress towards executing those ideas. It is interesting. It might work. But the field is strewn with good ideas that didn't work out for one reason or another."

According to Cox, the company has improved output in the Power Chip by reducing the size of the circular devices from 9 square centimeters – about the size of a quarter – to 1 centimeter.

Such a reduction in the active area of the Power Chip may require an array of smaller devices rather than a few larger ones, but Cox said that the manufacturing process is inherently low-cost – "a few pennies a watt" – and entails no moving parts or exotic materials.

He added that the company plans to pursue high-margin defense and aerospace applications for Power Chips and Cool Chips such as guided missiles and smart bombs or deep space probes.

Cox said that the company expects to deliver prototypes to potential customers for evaluation in the coming months and the company will be ready for volume production at the end of that evaluation process "in two to three years."

Cool Chips' Brian Von Herzen will discuss how the technology could help keep computer chips running cooler at the Technology Venture Forum sponsored by RTI in Dallas Oct. 28-30.

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