

# Biothermal Battery

Alexandra Dempsey

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**Biophan Technologies Inc.** announced on August 17, 2004 that it made an agreement between its Thermoelectric-Bio subsidiary and NASA for the joint development of high-density, nanoengineered thermoelectric materials for use with implantable medical devices. Research will be conducted at the NASA Ames Research Center for Nanotechnology at Moffett Field in California.

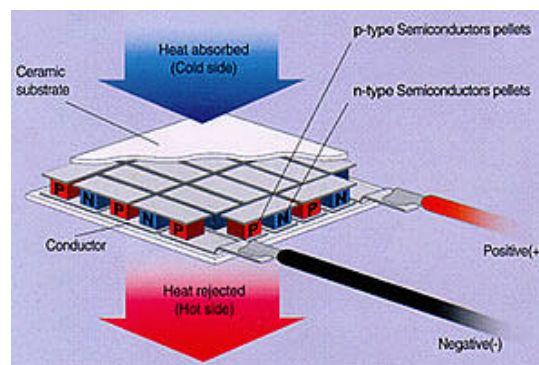
## Why Thermoelectric?

The human body naturally expends heat from the core to the surface; a useable temperature differential to create power from an appropriate TE material.

Currently, implantable electromedical devices have to be replaced every few years due to short battery life. Biophan's aim is to develop a thermoelectric power system based on temperature differentials in the human body.

TE-Bio developed a patented innovation in thermoelectric materials using nanoscale-based, thin-film materials to convert body heat into electrical energy. The resulting power can be used to "trickle charge" batteries for medium-power devices such as defibrillators, or to directly power low-energy devices, such as pacemakers. These power systems have the potential to run for as long as 30 years—a five-fold increase in service life over existing technology—and thus may reduce the number of replacement implant medical procedures needed throughout a patient's life, reducing costs and potential complications.

Semiconductor materials that produce electrical energy as a result of differential temperatures between hot and cold surfaces of the material.



## Technology

- TE-Bio has worldwide exclusive license to patent # 6,640,137 "Biothermal Power Source for Implantable Devices"
- Technical challenge: create TE module for 100  $\mu$ W power at 3V with 1°C temperature delta TE module will require approximately 4,000 elements on a 6 cm<sup>2</sup> surface

## Technology Competitors

- Lithium Ion battery technology provides rechargability and extended battery life.
- Lithium/carbon monofluoride battery technology has been developed in mid 90's, though has not been widely used.
- Nanocrystalline cathode components have been developed that extend Lithium battery life. None of these competitors currently offer the potential to provide 30+ years of service life.

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<http://www.biophan.com>  
<http://www.devicelink.com>  
<http://www.ipt.arc.nasa.gov>