APPLICATIONS OF THERMOELECTRICS

Automotive

A major contributor to waste heat is in the transportation sector where only 25% of the fuel's energy ends up as useful energy. Roughly 75% of the energy produced during combustion is lost through the exhaust or engine coolant in the form of heat. Thermoelectrics are ideal for vehicle applications as they are small, have no moving parts, and are relatively efficient at the engine exhaust temperatures that are typically 300-500°C. By utilizing a portion of the lost thermal energy to charge the battery instead of using an alternator, the overall fuel economy of the vehicle can be increased by about 10%.

Commercial & Residential Power Generation

A typical Carnot efficiency limited steam power plant is only 40% efficient, losing most of the available energy in the form of waste heat. A thermoelectrically-assisted steam power plant utilizing this waste heat to produce energy can increase its energy efficiency to about 90%. Thermoelectric systems are ideal for small cogeneration such as in a single family home because they could be small and silent. A small cogeneration plant in the home would produce electricity whenever the heat is needed. The added fuel consumed to produce the electricity has essentially the same energy content as the electricity produced. Also the application of thermoelectric devices to furnaces and other heat dissipating devices in a home can greatly increase the energy efficiency of a home.

Space Exploration

An interesting application of thermoelectric power generation is in space exploration. In this application, a radioisotope thermoelectric generator is used to convert radioisotope heat into electricity . In such a device, the heat released by the decay of a radioactive material is converted into electricity by the Seebeck effect using an array of thermocouples. Radioisotope thermoelectric generators have been used to provide power in satellites, space probes and unmanned remote facilities. Radioisotope thermoelectric generators are usually the most desirable power source for unmanned or unmaintained situations needing a few hundred watts or less of power for durations too long for fuel cells, batteries or places where solar cells are not viable.

Current Research

Electrochemical Deposition of Nanowires

New research is focused on electro-deposition of thermoelectric nano-wires using porous aluminum oxide as a template. In this process, the electrically conducting thermoelectric material is electrodeposited from solution within the empty channels of an electrically insulating alumina template. This yields dense arrays of parallel, cylindrical, high aspect ratio nano-wires allowing for increased electron flow, thus increasing the electrical output of the thermoelectric device.

Super Lattice Improves Thermoelectric Response Times

The Office of Naval Research and the Defense Advanced Research Projects Agency are funding the development of new thermoelectric materials using alternating layers of bismuth and telluride antimony that allow the material to respond 23,000 times faster than existing thermoelectric materials. A super lattice was created that allows electrons to flow freely allowing for faster response times but limits thermal processes.

Advantages vs. Disadvantages

One big advantages of thermoelectrics is that does not have any materials that need to be replenished. It also operates with almost no noise and does not have any moving parts so it can have up to 100,000 hours of steady state operation. Another advantage is that it can conveniently be reversed from heating to cooling. The main disadvantage is its efficiency. Current research is in developing materials that can operate at high temperature gradients and conduct electricity without conducting heat. This research will hopefully lead to thermoelectrics with higher efficiencies.

Source : http://me1065.wikidot.com/thermoelectrics