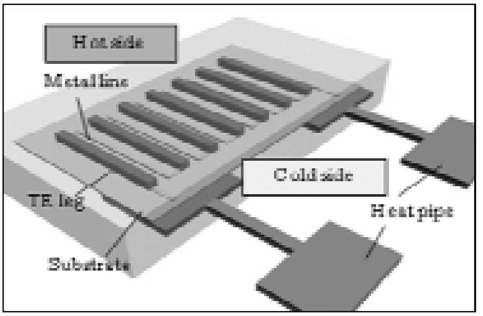
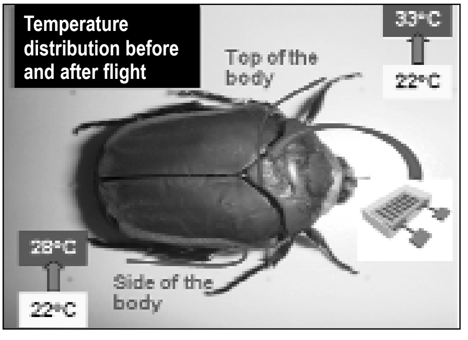
A Micro Thermoelectric Generator for Microsystems

Niloufar Ghafouri, Hanseup S. Kim, and Khalil Najafi

The rapid growth of portable and low-power electronic systems has increasingly demanded power-harvesting methods to replace conventional electrochemical batteries to achieve longer lifetime, smaller volume, and better portability. One potential approach is on-site energy scavenging from various environmental sources, such as ambient heat, solar energy, and vibration. In this project, we seek to develop an energy scavenger for generating power from a heat source, specifically from the body heat of an insect (beetle). The dissipated heat from the beetle body during flight is converted to electrical energy using a microscale thermoelectric scavenger utilizing an array of integrated thermocouples. The ultimate goal of this project is to develop a micro thermoelectric power generator (TEG) that is capable of generating 20μW–50μW/cm^2/°C from the beetle body heat before and during flight. Flying insects can increase their body temperature by as much as 10°C during flight. In this particular application where the host is a small insect (beetle), the scavenger could be implanted inside the beetle body during pupa stage. The TEG will be placed in the region of the body with the maximum temperature difference to the ambient to generate the most power. Temperature distribution over a beetle body was measured to determine the best location for the TEG. This project is supported by HI-MEMS program of the Defense Advanced Research Projects Agency under grant number F016709.



Schematic of the lateral thermoelectric generator.



Temperature measurements on flying beetles and proposed placement of the TEG.