

# Cooling of Silicon Structures Using an Integrated Peltier Element

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A silicon membrane is cooled by the Peltier effect using a Peltier module which is a junction between a metal and the monocrystalline silicon of a membrane. A cooling of 1 K is obtained. The device can be applied for humidity measurement near the dew point.

## 1. Introduction

Thermal structures are one of the most important applications of microsystems. Numerous thermal transducers have been developed for the measurement of IR radiation (thermopiles, bolometers), flow, high-frequency electrical power and gas analysis. Many of these structures have the common feature that an isolated structure, which is a membrane or a cantilever, is heated by an electrical current and the heat transfer is measured. Sometimes it is desirable not to heat a membrane, but to cool it. The electrical current can be used for cooling through the use of the Peltier effect. It is found that cooling is much harder to achieve than heating. We have investigated possible cooling methods using a theoretical model and with the realization of a cooled membrane.

Cooling is rather weak, but there is one application where a temperature reduction of only 1 K is necessary. This is the measurement of humidity near the dew point by the dew-point depression method. This type of detection is needed for the measurement of the humidity of soil.<sup>(1)</sup> The soil water content is most important in agriculture, as well as in experimental soil science. The air within the soil is normally very wet, in the range of 99% relative humidity to the dew point (100%). For the relative humidity of the air in the soil to decrease

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