

Peltier Tip Microcalorimeter

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The well-known Peltier effect refers to the fact that heat is generated or absorbed at a thermocouple junction, that is, a junction of two dissimilar metal wires, depending on the direction of electric current. Previously we developed an ac microcalorimeter utilizing the Peltier effect of a thermocouple junction as an ac power source and another thermocouple as a sensor [1]. This Peltier calorimeter allowed us to measure the absolute value of the heat capacity of small solid samples with submilligrams of mass in the temperature range of 15-420 K. We also developed a novel calorimeter, termed as the Peltier tip calorimeter, consisting of a single thermocouple junction (Peltier tip) which is used as a heater and a sensor simultaneously. The Peltier tip calorimeter is capable of measuring the heat capacity of a small solid sample with sub-milligrams of mass. It is emphasized that the Peltier tip calorimeter is also capable of measuring the heat capacity and thermal conductivity of a liquid sample [2], and it bears strong implications on the thermophysical properties of nano-fluids. It is demonstrated that the Peltier tip has a potential as a local probe for scanning thermal microscopy, and that it is capable of measuring heat conduction of a gas and therefore can be used as a sensitive vacuum sensor [3] and an acceleration sensor [4]. It is further demonstrated that because the Peltier tip can be scaled down with the MEMS technique, it offers wide applications in measuring heat transport on a nanometer scale.

[1] I. K. Moon et al., *Appl. Phys. Lett.* **76**, 2451 (2000).

[2] D. H. Jung et al., Preprint.

[3] Korea Patent reg. number 407815 (2003); US Patent reg. number 6727709 (2004); Japan Patent reg. number 3452913 (2003).

[4] Korea Patent applied 10-2004-0061995 (2004).