A METHOD FOR THE DETERMINATION OF THE PELTIER NUMBER

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We consider an indirect method of determining the Peltier number for a semiconductor thermoelectric element, and this method is based on measuring the initial dynamic steepness of the volt-ampere characteristic.

The methods used to measure the Peltier number [1] involve heat measurements which require special equipment.

The proposed method of determining the Peltier number is based on replacing the thermal measurements with electrical measurements.

According to the general theory [1], the volt-ampere characteristic of a semiconductor thermoelectric element can be presented in the form

$$U = IR + \alpha\Delta T =$$

$$= IR\left[1 + \frac{z}{\alpha}(\Pi - 0.5IR)\right] - \frac{z}{\alpha}RQ_0, \qquad (1)$$

where the temperature difference across the junctions

$$\Delta T = \frac{1}{k}(I\Pi - 0.5I^2R - Q_0),$$

while the heat conduction between the junctions

$$k = -\frac{\alpha^2}{Rz}.$$

Having determined the dynamic slope of the volt-ampere characteristic in the form

$$S_d = \frac{dU}{dI} = R\left(\frac{z}{\alpha}\Pi + 1\right) - \frac{z}{\alpha}R^2I, \qquad (2)$$

for a current I = 0 we find that the initial dynamic slope S_0 can be expressed as

$$S_0 = S_d(0) = R\left(\frac{z}{\alpha}\Pi + 1\right), \qquad (3)$$

whence

$$\Pi = \frac{\alpha}{z}\left(\frac{S_0}{R} - 1\right). \qquad (4)$$

According to (4), the Peltier number is defined by the efficiency parameter z, the thermal emf coefficient α, the thermocouple resistance R, and the initial dynamic slope of the volt-ampere characteristic of the thermocouple.

The initial dynamic slope of the volt-ampere characteristic is defined as the slope of the tangent to the characteristic for the current I = 0. To raise the accuracy in the determination of the Peltier number, the thermocouple parameters z, α, R, and the volt-ampere characteristic of the thermocouple must be determined at the same temperature.

REFERENCE

1. A. F. Ioffe, L. S. Stil'bans, E. K. Iordanishvili, and T. S. Stavitskaya, Thermoelectric Cooling [in Russian], Izd. AN SSSR, 1956.

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