北京航空航天大学

实验报告

[redacted]

日　期:

评　分:

实验名称: thermal conductivity of poor conductive material: measured by steady-state method.

1. Experiment Purpose:

1>. Get familiar with the basic problems in thermal experiment calorimetry and temperature measurement.

2>. Understand the importance of aranging experiments and choosing parameters in terminal experiments.

3>. Get familiar with the use of basic instruments in the experiment.

2. Experiment Steps:

1>. According to the steady-state method, we have to get a stable temperature distribution, which will take a long time. In order to improve the efficiency, the power supply voltage of infrared lamp can be increased to 220V and then reduced to 110V after heating for about 5 minutes. Then read the temperature indication every 2~5 minutes. Then read the temperature indication. After reading the stable θ_1 θ_2, remove the sample and reheat. When the temperature of copper plate is about 10°C than θ_2, remove cylinder A and let brass plate P cool naturally. Read the temperature indication value of P disk every 30 seconds, and finally select the measurement number near θ_2 to calcute the cooling rate $\left.\frac{\delta\theta}{\delta t}\right|_{\theta_1=\theta_2}$.

2>. When placing the cylinder and disc, pay attention to make the jack for placing the thermocouple on the same side as Dervar bottle and digital millivo-ltmeter. When the thermocouple is inserted into the small hole, some silicone oil should be applied and inserted into the bottom of the jack, so that the termcouple temperature measuring and the copper plate are in good contact. The cold end of the thermocouple is inserted into a thin glass tube dripped with silicone oil, and then the glass tube is immersed in the ice water mixture.

3). The geometric dimensions of sample disk B and brass dish P can be measured with vernier caliper for many times to obtain the average value. The mass m (about 1kg) of copper plate can be weighed by electronic balance.

4). In this experiment, copper constantan thermocouple was used to measure the temperature. The principle of thermocouple temperature temperature measurement is a closed loop composed of two different conductors or semiconductors. If their nodes are at different temperatures θ_0 and θ the loop will have thermoelectric $EMF = \varepsilon(\theta, \theta_0)$.

5). Generally $\theta_0 = 0°C$. It is call the cold end; when θ is placed in the measured medium. We can use ε to determine the temperature different materials of connecting wires and display instruments into the thermocouple circuit. It can be proved that as long as the temperature at both ends of the intermediate conductor connected in the thermocouple is the same, the ε of the total thermocouple circuit will not charge. Based on this, the thermocouple thermometer was refilled to increase its service life. The thermoelectromotive force was measured by digital voltmeter. For copper constantan thermocouple, the themperature difference electromotive force is about 4.2°C when the temperature difference is 100°C. So it should be equaiiped with a digital voltmeter which can read 0.01 mv, and whose range is not less than 10mv.

Because the temperature of the cold end of the thermocouple is 0°C. The ratio of the thermal electromotive force to the temperature to be measured is constant when the temperature range of the thermocouple is not too large. Therefore, the value of electromotive force can directively repect the temperature value in equation.

Discussion of the questions:

1. Question one:

It mainly comes from the difference between temperature on and temperature two. The terminal conductivity of the plywood is small. and the temprature of difference between the upper and lower parts is large. Because the three boards, A, B and P are all hard boards, there must be an air layer in the middle, and the temperature is measured by the thermocouple and digital multimeter, so the error of temperature one and temperature two is large.

2. Question two:

Because of the low thermal conductivity of air, it is negative error. The error, The error can be reduced by pressing ABP tightly with adjusting bole. wiping the upper and lower surfaces and applying silicone oil.

3. Question three:

The metal thermal conductivity is large, because the $\theta_1-\theta_2=\frac{d\theta}{\delta t}\frac{h}{ks}$, in order to ensure that the $\theta_1-\theta_2$ is large enough to add h/s to become a rod, choose a metal rod with good verticality, small area and long length, so that it is in contact with the copper plate as well as possible, and wrap the surface with insulation material, basically meet the one-dimensional conditions.

Formulation: $k=mpc\frac{\delta\theta}{\delta t}\frac{d_p+4h_p}{d_p+2h_p}\frac{h_B}{\theta_1-\theta_2}\frac{2}{\pi d_B^2}$