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DESIGN OF WIND SPEED SENSOR FOR THE CABIN OF MANNED SPACECRAFT

Abstract

The manned spacecraft is in the state of micro gravity when it flights on orbit. The forced convection is necessary to ensure the crew's health and the thermal stability. The wind speed measurement in the manned spacecraft cabin is valuable for the air conditioner arrangement and the thermal control. In this paper, a wind speed sensor based on the principle of heat dissipation was introduced for measuring the low speed air flow in the spacecraft cabin. The sensing element is composed of a glass spheres, an electric wire heater and more than two thermocouples. The thermocouples, located at the region close to the spiral electric wire heater, are connected in series to increase the output signal. Such a structure is encapsulated in a glass sphere, the sensing element, with a diameter of less than 1mm. The conditioner circuit of the sensor is composed of a constant current source and a thermocouple voltage amplification circuit. The glass sphere is heated by the electric wire heater. When there is no air flow, the temperature of the glass sphere is constant at about 473K. The temperature changes with the wind speed. The wind speed is calculated by the results of the measured temperature of the thermocouple. The theoretical analysis of the nonlinear relationship between the output voltage signal and the wind speed was given in this paper. The dynamic characteristic of the sensor was evaluated by numerical simulations and experiments, and both results agree well. The test results show that the precision of the sensor is 0.02m/s, which satisfies the measurement requirements of the manned spacecraft. Moreover, the sensor has the advantages of small volume, light weight and high reliability. It is suitable for the wind measurement in manned space missions.