Spectral Emissivity Measurement Method Based on Radiation Power Compensation

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A novel method for measuring the normal spectral emissivity of materials was proposed by the determining of the ratio between the reduced value of heating power and the compensated value of radiation power. In vacuum and low temperature environment, radiative heat transfer is the only way of heat exchange. The material is heated and stabilized at a certain temperature. When the spectral radiation with power P was incident on the material surface, of which the temperature increased for the absorption of energy from the incident radiation. In order to maintain the temperature, the power of heating should be reduced appropriately under the control of PID. According to the conservation of energy, the reduction of heating power was well-founded to reflect the absorptivity of materials under the condition that the incident radiation power is constant. At this point, the emissivity of a material is equal to its absorptivity based on Kirchhoff's law. As long as the reduction ΔP of heating power and the power P of the incident radiation were measured in the state of constant temperature, the spectral emissivity of materials was calculated from the ratio ($\Delta P/P$). Refer to the calculated emissivity of ceramics and metal materials by Lorenz and Drude model, simulation experiments of emissivity measurement of SiC and Al were carried out. Including the ambient temperature, the effectiveness of heating power and the stability of radiation power, the influencing factors of measurement uncertainty were discussed.